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DIGENETIC TREMATODES FROM MARINE FISHES OFF THE COAST OF KUWAIT, ARABIAN GULF: SUPERFAMILY HEMIUROIDEA

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Eight species of Hemiuroidea are reported: *Allostomachicola secundus* (SRIVASTAVA, 1937) YAMAGUTI, 1958 from *Chirocentrus nudus* (Chirocentridae); *Ectenurus trachuri* from *Trachurus trachurus*, *Caranx kalla*, *Scomberoides commersonianus* (Carangidae) and *Rachycentron canadum* (Rachycentridae); *Erilepturus hamati* (YAMAGUTI, 1934) MANTER, 1947 from *Lutjanus russelli* (Lutjanidae), *Otolithes ruber* (Sciaenidae), *Pseudorhombus arsius* (Bothiidae), *Scomberoides commersonianus* (Carangidae) *Therapon* sp. (Theraponidae); *Lecithocladium angustiovum* YAMAGUTI, 1953 from *Caranx kalla* (Carangidae); *Lecithochirium acutum*, CHAUHAN, 1945 from *Trichiurus lepturus* (Trichiuridae); *Aponurus laguncula* LOOSS, 1907 from *Siganus oramin* (Siganidae); *Lecithaster indicus* SRIVASTAVA, 1935 from *Otolithes ruber; Aphanurus stossichii* (MONTICELLI, 1891) LOOSS, 1907 from *Sardinella perforata*, *Ilisha elongata* (Clupeidae), *Thryssa whiteheadi* (Engraulidae) and *Mulloidichthys auriflamma*, (Mullidae).

Key words: Arabian Gulf, Kuwait coast, marine fishes, trematodes, Hemiuridae, Lecithasteridae, Bunocotylidae

INTRODUCTION

This paper, the fifth in a series on digenetic trematodes of marine fishes off the Kuwait coast of the Arabian Gulf by SEY (1995), SEY and NAHHAS (1997), SEY *et al.* (1998), and NAHHAS *et al.* (1998) collected by the second author reports or describes eight species belonging to three families in the superfamily Hemiuroidea as defined by GIBSON and BRAY (1979).

MATERIALS AND METHODS

Collection, preservation and preparation of the specimens are described in SEY and NAHHAS (1997). All specimens were obtained from the stomach of their hosts. Date of collection, prevalence, mean intensity, and abundance as defined by BUSH *et al.* (1997), and accession numbers are presented in Table 1. Measurements are expressed in micrometers and indicated as a range, length followed by width and the mean in parenthesis; numbers are rounded to the nearest decimal.

Measurements on species from multiple hosts are presented in Tables 2–4 and combined data included in description of each species. Drawings were made by tracing photomicrographs, and details filled in from microscopic observations. Representative specimens of some species are deposited in the parasitological collection of The Natural History Museum BM(NH), London, others will be

Table 1. Prevalence (P), mean intensity (M.I.), abundance (A) of 8 species of hemiuroids from marine fishes off the Kuwaiti coast

Host	digenean	Collection date	%P	M.I.	A.	Accession No. @ BM(NH)
Chirocentrus nudus	*Allostomachicola secundus*	10 Mar. 1994	25	1	1	2001.4.9.1
Trachurus trachurus	*Ectenurus trachuri*	10 May 1995	36	4	4	1999.2.25.21
Caranx kalla	*Ectenurus trachuri*	11 Apr. 1996	10	8	8	1999.2.25.22
	Lecithocladium angustiovum	11 Apr. 1996	10	1	1	2001.4.9.3
Scomberoides commersonianus	*Ectenurus trachuri*	21 Jun. 1995	11	5	5	1999.2.25.23
	Erilepturus hamati	10 Oct. 1996	11	2	2	
Rachycentron canadum	*Ectenurus trachuri*	21 Jun. 1995	20	1	1	
Otolithes ruber	*Erilepturus hamati*	10 Mar.1994 5 Mar. 1995 10 May 1995 5 Apr. 1996	15	6.8	1 13 12 1	1999.2.25.12 1999.2.25.11
	Lecithaster indicus	5 Mar. 1995			1	2001.4.9.2
Pseudorhombus arsius	*Erilepturus hamati*	28 Jan. 1995 2 Jun. 1995 25 Jun. 1995 18 Oct. 1995 19 Dec.1996	13	8.2	33 2 4 1 1	1999.2.25.13 –14
Therapon sp.	*Erilepturus hamati*	8 Jun. 1994	100	2	3 1	1999.2.25.16
Lutjanus russelli	*Erilepturus hamati*	21 Jun. 1995	20	4	4	1999.2.25.15
Trichiurus lepturus	*Lecithochirium acutum*	16 Mar. 1994	12.5	20	20	1999.25.2.20
Siganus oramin	*Aponurus laguncula*	10 Oct. 1996	33.3	1	1	2001.4.9.4
Sardinella perforata	*Aphanurus stossichii*	20 Jul. 1993 20 Jul. 1993	20	36	42 30	2001.4.1-8
Ilisha elongata	*Aphanurus stossichii*	15 Oct. 1993	16.6	2	2	2001.14.15
Thryssa whiteheadi	*Aphanurus stossichii*	10 Mar. 1995	100	75	75	2001.1.4.9-14
Mulloidicthys auriflamma	*Aphanurus stossichii*	13 Jun. 1993 15 Oct. 1993	11	1	1 1	2001.14.16

placed in the United States National Parasite Collection (USNPC) and HAROLD W. MANTER Laboratory (HWML), University of Nebraska State Museum, Lincoln, Nebraska. Fishes were identified by using the monograph of KURONUMA and ABE (1986) and updated from RANDALL (1995).

DESCRIPTION OF SPECIES

Family Hemiuridae LOOSS, 1899

Allostomachicola secundus (SRIVASTAVA, 1937) YAMAGUTI, 1958 (Figs 1–2)

Stomachicola secundus SRIVASTAVA, 1937
Pseudostomachicola secundus (SRIVASTAVA, 1937) SKRJABIN and GUSCHANSKAJA, 1954 in part

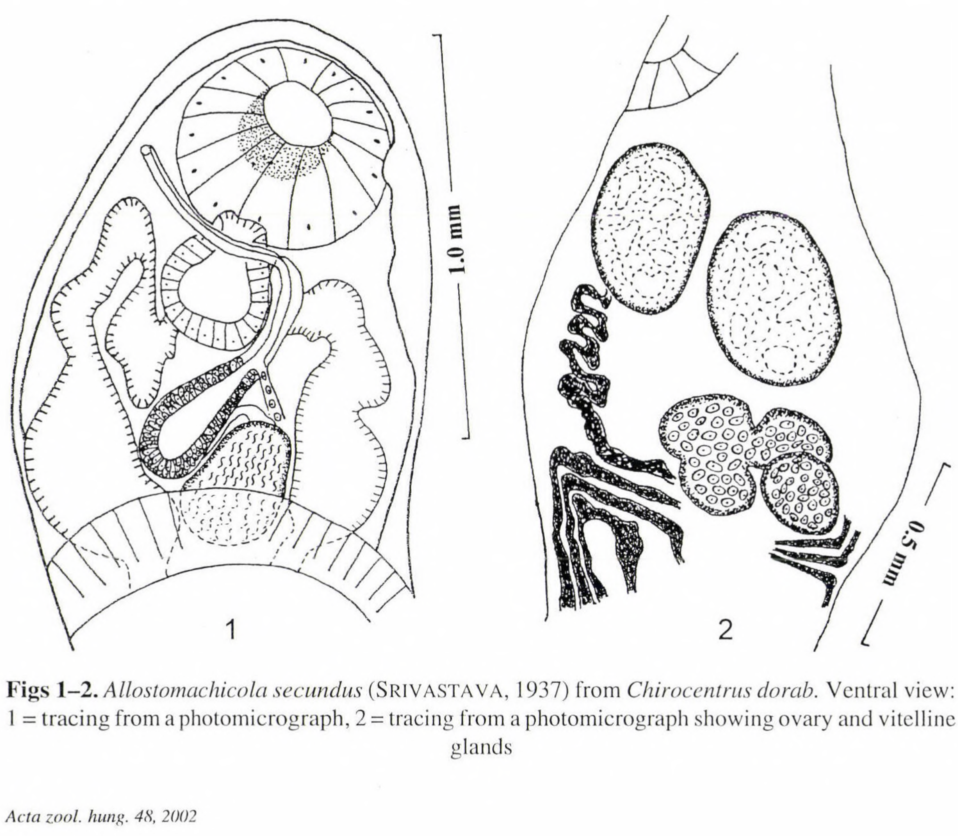
Host: *Chirocentrus nudus* (Forsskal) (Chirocentridae)

Description based on one specimen. Body elongate, sub-cylindrical, muscular, 10,465×1000 at level of ventral sucker; soma 4,425; forebody 1,125, hindbody 2,500; ecsoma fully extended, 6,000. Tegument smooth. Pre-oral lip absent. Oral sucker subterminal, 450×500; ventral sucker 800×1,000; sucker ratio 1:1.89. Pre-pharynx absent; pharynx pear-shaped, 315×255; esophagus absent; caeca, with prominent shoulders, extending posteriorly to near end of ecsoma. Testes inter-caecal, diagonal, almost contiguous, posterior to, but not overlapping, ventral sucker; anterior testis 410×350; posterior testis 450×385; seminal vesicle (Fig. 1) sac-like, 400×290, overlapping anterior level of ventral sucker, connecting by short duct to pars prostatica; pars prostatica about as long as but narrower than seminal vesicle, consisting of ovoid vesicle surrounded by prostate cells, and joined by metraterm at base of muscular hermaphroditic duct; hermaphroditic duct thick-walled; terminal part about 400 in length, protruding from genital pore at junction of oral sucker and pharynx and extending horizontally to right side. Ovary tetralobed, three united centrally, the fourth loosely connected (Fig. 2), almost midway between posterior testis and end of soma; seminal receptacle and Laurer's canal not evident; uterine coils extensive filling practically all ecsoma. Vitelline tubes long; four on right side and three indistinct on left just below ovary, overlapping caeca laterally, extending anteriorly to about posterior fourth of anterior testis and posteriorly entering short distance into ecsoma. Eggs 15–20×10–12. Genital pore at junction of oral sucker and pharynx. Excretory vesicle tubular; main canals uniting dorsal to junction of oral sucker and pharynx.

Remarks. The stomachicoline hemiurids include several nominal genera (*Stomachicola* YAMAGUTI, 1934, *Pseudostomachicola* SKRJABIN et GUSCHANSKAJA, 1954, *Allostomachicola* YAMAGUTI, 1958, *Acerointestinecola* JEHAN, 1970, *Cameronia* BILQEES, 1971, *Segmentatum* BILQEES, 1971, *Cestodera* BILQEES, 1971, and *Indostomachicola* GUPTA et SHARMA, 1973. The validity of some of these genera has been questioned by several investigators. GIBSON and BRAY (1979) considered *Pseudostomachicola*, *Indostomachicola* and *Acerointestinecola* synonyms of *Stomachicola*, a genus distinguished from *Allostomachicola*

chiefly by the post-acetabular location of the seminal vesicle. HAFEEZULLAH (1980) agreed with GIBSON and BRAY (1979) and added *Cameronia*, *Segmentatum* and *Cestodera* to the synonyms of *Stomachicola;* he also considered their species as junior synonyms of *S. muraenesocis* YAMAGUTI, 1934. GUPTA and GUPTA (1992), based on a study of whole mounts of 35 mature, 11 immature specimens, and sectioned material of *S. muraenesocis* collected from *Amphipnous cuchia*, *Synbranchus bengalensis* (Synbranchidae), and *Congermuraena anago* (Congridae) from the Puri coast of Bay of Bengal supported HAFEEZULLAH's conclusion; they observed many variations in their specimens which led them to conclude that several species of *Stomachicola*: *S. rubea* (LINTON, 1910), *S. mastacembeli* VERMA, 1973, *S. polynemi* GUPTA et GUPTA, 1974, *S. bayagaboni* SIDDIQI et HAFEEZULLAH, 1975, *S. singhi* GUPTA et AHMAD, 1975, *S. chauhani* PANDEY et TEWARI, 1984 and *S. chauhani* of GUPTA et SINGH, 1985 renamed by GUPTA and GUPTA (1992) *S. guptai* are also synonyms of *S. muraenesocis*.

In contrast with *Stomachicola*, four nominal species are reported in *Allostomachicola*: *A. secundus* (SRIVASTAVA, 1937) YAMAGUTI, 1958 from *Hemiramphus limbatus* (Hemiramphidae) and *Chirocentrus dorab* (Chirocentridae); *A. lep-*



Figs 1–2. *Allostomachicola secundus* (SRIVASTAVA, 1937) from *Chirocentrus dorab*. Ventral view: 1 = tracing from a photomicrograph, 2 = tracing from a photomicrograph showing ovary and vitelline glands

turusi (GUPTA et GUPTA, 1976) GUPTA et SINGH, 1985 from *Uroconger lepturus* (Congridae); *A. chirocentri* JEHAN et AZAM, 1975 and *A. rauschi* (GUPTA et AHMAD, 1978) GUPTA et SINGH, 1985 from *C. dorab*.

Allostomachicola secundus described briefly in 1937 and redescribed in 1939 from several specimens collected from *Hemiramphus limbatus* from Puri, Bay of Bengal, was characterized (SRIVASTAVA 1939) by 2 vitelline tubes, a dome--shaped trilobed ovary and a uterine seminal receptacle. SRIVASTAVA (1937) had described the ovary initially as "peculiarly tetra-lobed mushsroom-shaped". CHAUHAN (1954) studied a "para- or topotype" of *A. secundus* and found that a "receptaculum seminis was present, the ovary was tetralobed, specially the fourth lobe being a little lobate in appearance and the number of vitelline tubes was seven".

The thick muscular sub-cylindrical body of the Kuwaiti specimen made it difficult to dehydrate, clear for mounting, and consequently measure and describe certain parts. The organs anterior to the ovary were quite visible in the whole mount. Most of our observations, however, were made on the specimen after it was returned to the clearing agent methyl-salicylate. One particular difficulty was determining the origin and number of vitelline tubes; four tubes on the right side and three indistinct ones on the left were observed; coiled tubes longitudinally arranged and extending from the testicular level into the ecsoma were also seen on both sides. No vitelline reservoir was evident and the connection of the tubes to each other or to their origin could not be determined. Our specimen is referred to this species chiefly on the basis of similarities of the terminal male and female reproductive structures, topography of the other organs including extent of the vitellaria, and presence of caecal shoulders as described by SRIVASTAVA (1937, 1939) and redescribed by CHAUHAN (1954); the ovary is clearly tetralobed; the fourth lobe seems separated from the others. Our specimen has a strong resemblance to *A. rauschi* from *C. dorab* from Puri, Bay of Bengal. *A. rauschi*, described from a single specimen, is reported to have caecal shoulders, tetra-lobed ovary, 2 vitelline tubes, a sucker ratio of 1:2, egg size of 18–21×9–12, a genital pore posterior to pharynx but no seminal receptacle. *Chirocentrus dorab* was also reported by several investigators including GOPAL *et al.* (1984), and GUPTA and SINGH (1985) as host for *A. secundus*. None of these authors, or any other investigators, as far as we can determine, made any reference to the discrepancy between SRIVASTAVA's and CHAUHAN's descriptions with respect to the number of vitelline tubes and presence or absence of a seminal receptacle. GOPAL *et al.* (1984), who described in detail the terminal structures of the male reproductive system of *A. secundus* collected from the Waltair coast, reported position of the genital pore as ventral to the pharynx. However, except for indicating that the metraterm joins a short ejaculatory duct to form the hermaphroditic duct, nothing else was mentioned about male

structures. *A. chirocentri*, described from several specimens from the intestine of *C. dorab* from the Karachi coast, has 7 vitelline tubes, a spherical ovary, a seminal receptacle, sucker ratio of 1:<2 (their figure suggests about 1:1.2), eggs 20–23×14.5, but no caecal shoulders. *A. lepturusi*, described from one specimen, has caecal shoulders, 2 vitelline tubes, bean-shaped ovary, sucker ratio of about 1:1.7, and eggs 28–30×20–27 but no seminal receptacle; its seminal vesicle is described as being pre-acetabular, not extending beyond the anterior level of the ventral sucker. Considering the variations that were seen in the various taxa of *Stomachicola* and its synonyms, we believe that further study of specimens, including sectioning, from the *Allostomachicola* group to confirm presence or absence of a seminal receptacle, determine the origin and number of vitelline tubes and the position of the genital pore is necessary to confirm the validity of these species.

Ectenurus trachuri (YAMAGUTI, 1934) YAMAGUTI, 1970

Magnacetabulum trachuri YAMAGUTI, 1934

Hosts: *Trachurus trachurus* (LINNAEUS) (Carangidae)
Caranx (Atule) kalla CUVIER (Carangidae)
Scomberoides commersonianus LACÉPÈDE (Carangidae)
Rachycentron canadum (LINNAEUS) (Rachycentridae)

Measurements on specimens from each of the four host species are presented in Table 2. Description and combined range follow. Body elongate; soma 1,170–2400×335–570 in greatest width at level of ovary; forebody 205–450; hindbody 750–1600; forebody-hindbody ratio 1:3.3–4.7. Ecsoma 27–43% length of soma in well-extended specimens. Tegument plicated, plications encircling body anteriorly, extending from anterior end of body to posterior end of middle third of soma ventrally and almost to posterior end of soma dorsally, well developed in many, faint, even absent in few as a result of over-flattening. Oral sucker 80–160×100–180, surmounted by a preoral lip 5–32; ventral sucker in anterior fourth or third of soma, 260–500×230–450; sucker ratio 1: 2.43–3.00. Prepharynx absent; pharynx 55–87×55–95; esophagus shorter than or as long as pharynx; caeca extending to, but not reaching, end of ecsoma. Testes in middle third of body, diagonal (tandem in one specimen from *Scomberoides commersonianus*), entire, contiguous; anterior testis 112–175×70–180, posterior testis 112–245×95–200. Seminal vesicle tripartite, post- acetabular in most, postero-dorsal in few; posterior part largest, almost contiguous with anterior testis; anterior part smallest, connecting to pars prostatica by aglandular duct almost as long as ventral sucker; pars prostatica with conspicuous prostatic cells around its distal third or half, joining metraterm at base of thin-walled tubular or cylindrical hermaphroditic sac; hermaphroditic duct extending to anterior level of pharynx. Ovary post-testicular, entire, 75–240×88–210, near mid-soma, contiguous with or separated from posterior testis by one or two uterine coils; uterus extending slightly or not into ecsoma. Vitellaria immediately post-ovarian, in two groups of four and three digitiform lobes; lobe length 2–4 times width. Eggs small, numerous, 15–20×10–14. Genital pore ventral, near anterior level of pharynx. Excretory arms not uniting anterior to oral sucker.

Remarks: At least 17 nominal species have been reported in *Ectenurus* from different parts of the world including 7 from carangids. Our specimens are most similar to, and show many intermediate features in topography of internal structures of *E. trachuri* (YAMAGUTI, 1934) YAMAGUTI, 1970 and *E. lepidus* LOOSS, 1907. In *E. trachuri* the hermaphroditic sac is longer and cylindrical compared with that of *E. lepidus*. MANTER (1954) suggested that the "short and thick" her-

Table 2. Range and (mean) of *Ectenurus trachuri* from four host species

	Trachurus trachurus (3)	*Caranx kalla* (7)	*Scomberoides commersonianus* (5)	*Rachycentron canadum* (1)
Soma l	1370–2090	1170–1730	1820–2225	2400
w	410–500	335–500	420–570	450
	(1667×453)	(1507×404)	(2024×488)	
F'body	260–420	205–300	300–350	450
	(313)	(229)	(319)	
H'body	850–1340	750–1110	1150–1425	1600
	(1030)	(1084)	(1280)	
O.S. l	100–130	80–147	130–160	125
w	125–135	100–155	130–180	130
	(115×128)	(114×128)	(145×149)	
V.S. l	260–380	260–395	350–500	350
w	230–410	260–400	360–450	350
	(323×340)	(337×331)	(425×393)	
O.S.:V.S	1:2.43–3.00	1:2.47–2.89	1:2.63–3.00	1:2.74
	(1:2.77)	(1:2.76)	(1:2.78)	
Pharynx l	55–80	65–85	75–87	75
w	55–80	66–81	75–95	80
	(63×73)	(75×73.5)	(79×82)	
A. testis l	113–150	130–175	112–115	150
w	125–175	70–168	140–150	180
	(127×142)	(153×130)	(113×145)	
P. testis l	113–120	125–245	112–115	140
w	125–200	95–183	118–163	185
	(116×152)	(153×130)	(114×141)	
Ovary l	100–150	160–240	75–137	110
w	150–200	105–210	88–150	210
	(131×177)	(196×124)	(106×119)	
Eggs L×W	15–20×10–13	17–20×10–13	18–20×12–13	17–20×12–14

Abbreviation for Tables 2–4: l = length, w = width, F'body = forebody, H'body = hindbody, O.S. = oral sucker, V.S. = ventral sucker, A. testis = anterior testis, P. testis = posterior testis, S.V. = seminal vesicle

maphroditic sac figured by LOOSS (1907) "is evidently in a contracted state". GIBSON and BRAY (1986) questioned the accuracy of reports of *E. lepidus* from outside European waters. BRAY (1990), indicating that *E. trachuri* is predominantly a parasite of Carangidae (87%), considered *E. lepidus* of MANTER (1954), *E. lepidus* of MANTER and PRICHARD, (1960) and *E. virgula* of KOROTAEVA (1975) synonyms of *E. trachuri*. Details of the terminal reproductive structures for many species of *Ectenurus*, especially those from carangids of the Western Indo-Pacific, are lacking which makes comparison difficult; it is possible that several of these are also synonyms of *E. trachuri.* Our specimens are in agreement with the description by BRAY (1990) of *E. trachuri* from the Southern Indian Ocean. Two specimens were recovered from *Rachycentron canadum* (Rachycentridae), but only one was typical; the identity of the second could not be determined with certainty and is not included in this paper. Since these two specimens were recovered the same day as those from *Scomberoides commersonianus*, they were suspected to have originated from the latter. Our records, however, indicate that three fishes had been examined between the two hosts. No contamination is believed to have occurred.

AL-YAMANI and NAHHAS (1981) distinguished *Ectenurus* from the closely related genera, *Clupenuroides, Utervesiculurus*, *Clupenurus* and *Erilepturus* by lack of union of the excretory canals dorsal to the oral sucker-pharyngeal region in the former and its presence in the latter four.

It should be noted that whether the excretory canals at the anterior level of the worms unite or not is not known for several species in this group.

Erilepturus hamati (YAMAGUTI, 1934) MANTER, 1947

Synonyms: see BRAY *et al.* (1993*b*)

Hosts: *Pseudorhombus arsius* (HAMILTON-BUCHANAN) (Bothiidae)
Otolithes ruber (SCHNEIDER) (Sciaenidae)
Scomberoides commersonianus LACÉPÈDE (Carangidae)
Therapon sp.(Theraponidae)
Lutjanus russelli (BLEEKER) (Lutjanidae)

Measurements on specimens from each of the five host species are presented in Table 3. Description and combined range follow. Body elongate, sub-cylindrical; soma 1,200–4,375× ×380–1170 in greatest width at level of ventral sucker; ecosoma retracted in most, partially protruded in a few; forebody 500–1,850; hindbody 450–1,850; forebody to hindbody ratio 1: 0.8–1.3. Tegument smooth, few with fine striations. Oral sucker subterminal, 120–280×100–310; pre-oral lip present well developed in some, small in others; ventral sucker near midbody, 250–725 in diameter; sucker ratio 1:1.9–2.54. Pre-pharynx absent, pharynx ovoid 75–160×75–180; esophagus very short; intestinal

caeca extending partially into ecsoma. Testes inter-caecal, diagonal in most, somewhat symmetrical in few, tandem in two, contiguous or not, slightly posterior to ventral sucker; anterior testis 85–335×130–400; posterior testis 90–280×135–370. Seminal vesicle 100–600×80–330, thick-walled in some, less so in others, postero-dorsal to ventral sucker, large in some, small in others even in specimens from same host, extending to mid-level of ventral sucker only in large ones; details of terminal

Table 3. Range and (mean) of *Erilepturus hamati* from five host species. For abbreviation see Table 2

	Pseudorhombus arsius (8)	*Otolithes ruber* (20)	*Scomberoides commersonianus* (2)	*Therapon* sp. (4)	*Lutjanus russelli* (4)
Soma l	2160–3200	1530–4375	3500–3850	1450–2825	1200–1550
w	510–930	620–1125	1008–1170	460–920	380–520
	(2447×665)	(2798×849)	(3675×1089)	(2200×698)	(1419×468)
F' body	850–1250	560–1850	1175–1550	500–1300	500–650
	(972)	(1100)	(1363)	(931)	(563)
H' body	950–1500	620–1850	1575–1675	625–1025	450–600
	(1106)	(1184)	(1625)	(830)	(531)
F'body : H'body	1 : 1.1–1.2	1:1.0–1.2	1 : 1.0–1.3	1 : 0.8–1.25	1 : 0.9
O.S. l	140–210	155–280	260–270	138–230	120–160
w	140–210	160–300	305–310	150–265	100–170
	(168×172)	(226×235)	(265×308)	(190–214)	(145×148)
V.S. l	310–450	350–700	600–725	325–525	250–375
w	300–410	350–625	580–725	325–525	250–375
	(369×364)	(517–496)	(663×653)	(438×438)	(325×325)
O.S.:V.S.	1:1.95–2.40	1:1.9–2.40	1:2.00–1: 2.54	1:2.00–1:2.26	1:2.12–1:2.34
	(1:2.16)	(1:2.18)	(1:2.30)	(1:2.17)	(1:2.30)
Pharynx l	75–113	88–160	90–145	90–125	75–100
w	85–125	100–150	140–180	95–135	75–113
	(94×99)	(130×127)	(118×160)	(108×118)	(84×90)
A. testis l	160–220	160–300	235–335	85–200	85–160
w	150–250	200–320	335–400	140–240	130–165
	(192×198)	(226×218)	(285×368)	(149×193)	(119×149)
P. testis l	170–270	150–280	240–260	100–200	90–130
w	170–280	200–320	350–370	150–240	135–170
	(214×210)	(235×227)	(250×360)	(153×208)	(109×153)
Ovary l	130–230	150–260	260–310	125–160	75–100
w	150–280	180–360	420–430	175–260	100–138
	(178×199)	(220×275)	(285×425)	(138×219)	(81×110)
Eggs l	21–23	17–24	20–23	17–2010–12	17–2010–12
w	11–13	11–15	10–11		
S.V. l	150–370	100–600	450–550	150–270	138–235
w	100–180	80–330	300–320	90–120	87–113
	(273×144)	(321×192)	(500×310)	(213×103)	(178×105)

male structures as described by YAMAGUTI (1934) for *E. hamati, E. platycephali* and *E. paralichthydis*. Ovary unlobed, wider than long, almost midway between posterior testis and end of soma, 75–310×100–430; seminal receptacle absent; LAURER's canal not seen; uterine coils extensive, extending slightly posterior to vitellaria but not intruding into ecsoma; uterine vesicle present in some, not evident in others from the same host, joining hermaphroditic duct at base of hermaphroditic sac. Vitelline tubes digitiform, in two lateral groups of 4 and 3, not reaching end of soma. Eggs thin-shelled, 17–24×10–15. Genital atrium ovoid to oblong, pore median near anterior level of pharynx. Main excretory canals united dorsal to pharynx.

MANTER and PRITCHARD (1960) were the first to suggest that *Uterovesiculurus* SKRJABIN et GUSCHANSKAJA, 1954 is a synonym of *Erilepturus* WOOLCOCK, 1935 indicating that the uterine vesicle, a terminal dilation of the uterus, which was the basis for erecting the genus *Uterovesiculurus*, may be a transient feature. Our specimens from the different host species, as well as several from the same host confirm the transiency of this feature; they also confirm the synonymy of *Ectenurus hamati*, *E. platycephali* and *E. paralichthydis*. All three have similar terminal reproductive structures, but differ in arrangement of the testes and size. One notable feature seen in some of our specimens was a parallel-sided hermaphroditic sac (sinus sac) in some specimens from the same host, a characteristic of *E. equalis* YAMAGUTI, 1970, *E. synodi* YAMAGUTI, 1970 and *E. trachinocephali* YAMAGUTI, 1970 according to BRAY *et al.* (1993*b*). Except for this feature, all other structures were practically identical. Differences in size varied a great deal among our specimens from the same host and host species (Table 3); in general the largest were from *Scomberoides commersonianus* and the smallest in *Lutjanus russelli.* Other than size, the specimens from the various hosts were very similar.

GIBSON and BRAY (1979) and BRAY *et al.* (1993*b*) accepted MANTER and PRITCHARD's generic synonymy and placed in, or accepted, the synonymy of 27 nominal species (eight *Ectenurus*, 18 *Uterovesiucularis* and *Lecithochirium neopacificus*) with *E. hamati*.

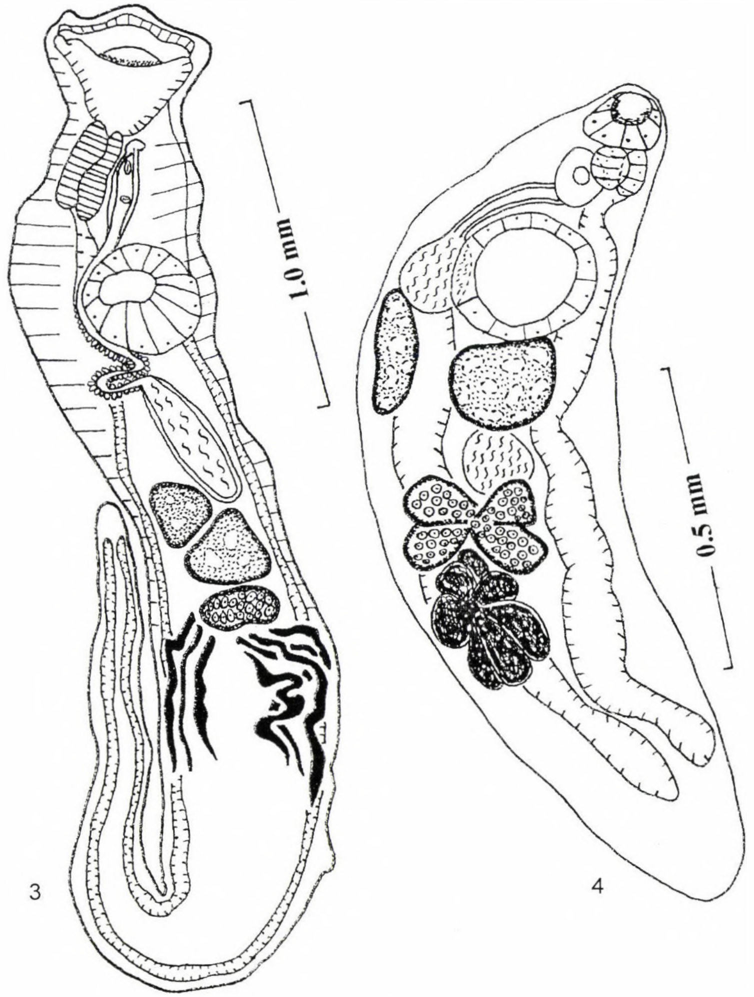
Lecithocladium angustiovum YAMAGUTI, 1953
(Fig. 3)

Synonyms: see GIBSON and BRAY (1986), BRAY (1990)

Host: *Caranx kalla* CUVIER et VALENCIENNES (Carangidae)

Description based on one specimen. Body elongate, 4,575×550 at ovario-vitelline region; soma 2,700; forebody 700, hindbody 1650; ecsoma almost fully extended 1,875×450 wide near junction with soma, gradually narrowing to 120 near posterior tip. Tegument plications along most of soma. Oral sucker funnel-shaped, 350×470 at anterior end; ventral sucker 350×370; sucker length ratio 1:1; sucker width ratio 1: 0.79. Prepharynx absent; pharynx cylindrical, 350×170; esophagus

short, bifurcating anterior to ventral sucker; caeca extending to posterior end of ecsoma. Testes globular to slightly triangular, contiguous, almost tandem, at junction of anterior and mid-thirds of soma; anterior testis 250×250, posterior testis 250×260. Seminal vesicle, spindle-shaped, 550×120, thick-walled, wall 10–15 in thickness, extending to junction of testes; pars prostatica tubular, winding twice posterior to ventral sucker, externally lined with prostate cells along its posterior half. Ovary entire, 140×240, immediately posterior to posterior testis; uterine tubes overlapping, but not separating, gonads, extending into anterior third of ecsoma, and anteriorly joining tip of prostatic tube just above base of ventral sucker. Seminal receptacle absent. Vitelline follicles tubular, 4 dextral and 3



Figs 3–4. 3 = *Lecithocladium angustiovum* YAMAGUTI, 1934 from *Caranx kalla*. Ventral view. Tracing from a photomicrograph, uterus not shown. 4 = *Lecithaster indicus* SRIVASTAVA, 1935 from *Otolithes ruber*. Ventral view. Tracing from a photomicrograph, uterus not shown

sinistral, not extending anterior to ovary or into ecsoma. Hermaphroditic duct tubular, long, opening into genital pore at junction of oral sucker and pharynx. Eggs 15–18×10–13. Excretory arms reaching pharyngeal region, their union dorsal to junction of oral sucker and pharynx could not be determined.

Remarks. At least 72 nominal species have been reported to date in the genus *Lecithocladium* of which about 40 from fishes of the Bay of Bengal and the Arabian Sea; two of these: *L. elongatum* GUPTA, 1981 and *L. hanumanthai* TANDON, 1982 (reported in a thesis) were described from *Caranx kalla*. AL-YAMANI and NAHHAS (1981) reported *L. bulbolabrum* REID, COIL et KUNTZ, 1966 from *Johnius aneus* (Sciaenidae) and *L. unibulbolabrum* FISCHTHAL et THOMAS, 1971 from *Rastrelliger kanagurta* (Scombridae). The only significant difference between the two Kuwaiti species that was noted at the time was the presence of an oral bulb in the latter compared with two in the former, a characteristic considered common but highly variable in this genus. PARUKHIN (1970) reported *L. angustiovum* from *Selar crumenophthalmus* (Carangidae) and *L. bulbolabrum* from *Rastrelliger brachisoma* (Scombridae) from the Gulf of Aden–Red Sea but gave no detailed descriptions. GIBSON and BRAY (1986) questioned the validity of many of the Indo-Malaysian species and placed them into 7 groups (A-G); group A is *L. angustiovum* which also includes *L. bulbolabrum* REID, COIL et KUNTZ, 1966, *L. unibulbolabrum* of AL-YAMANI et NAHHAS, 1981, and *L. scombri* YAMAGUTI, 1953 as synonyms. BRAY (1990) added *L. microlepidotusi* GUPTA et GOVIND, 1981, *L. manteri* GUPTA et PURI, 1982, *L. siddiqii* GUPTA et GUPTA, 1987, and *L. tewarii* GUPTA et GUPTA, 1987. Our specimen from *Caranx kalla* is very similar to those reported by AL-YAMANI and NAHHAS (1981) except for larger size and comparatively larger structures; minor differences are observed which include the absence of bulbs at the posterior end of the oral sucker, and somewhat wider eggs; the ovary is contiguous with the posterior testis and the tips of the vitelline follicles barely reach the ecsoma. In *L. angustiovum* as figured by YAMAGUTI (1953), PARUKHIN (1970) and BRAY (1990), the ovary is at the soma-ecsoma junction and the vitelline tubes are mostly in the anterior part of the ecsoma. This suggests to us constant features in a species collected from different host species and different geographic locations. This is in contrast with the more anterior location of these two structures in *L. bulbolabrum* as figured by REID *et al.* (1966), AL-YAMANI and NAHHAS (1981) and the present material. The Indo-Malaysian species placed in GIBSON and BRAY's (1986) group A (*L. angustiovum*) and the additional species listed in BRAY (1990), show variable distribution of the ovario-vitelline complex. BRAY (pers. comm.) suggested that the differences are very slight and probably could be the result of the variable extension of the ecsoma or differences in fixation. Several of the Indian species listed as synonyms in BRAY

(1990) show this variety of locations of the ovario- vitellarium complex ranging between an anterior location as reported for the Kuwaiti specimens and ones near or at the soma-ecsoma junction.

Lecithochirium acutum CHAUHAN, 1945

Host: *Trichiurus lepturus* LINNAEUS (Trichiuridae)

Description and measurements based on 13 specimens.

Body elongate, subcylindrical; soma 2,610–5,475×375–875 (3,878×650) at acetabular level; forebody 375–775 (592); hindbody 1500–4300 (2842); ecsoma partially retracted in most, 25–33 % of total body length in well extended specimens. Pre-oral lip well-developed, 25–45 (30) long. Presomatic pit glandular with oval opening, about midway between anterior level of ventral sucker and pharynx, often overlapping junction of bipartite seminal vesicle. Tegument smooth. Oral sucker subterminal, 120–250 (168)×130–225 (168); ventral sucker 300–550 (460)×320–550 (465), no internal elevations seen; sucker ratio 1: 2.23–1:3.15 (1:2.64). Prepharynx absent; pharynx 60–110×60–225 (90×101), esophagus very short, caeca extending to near posterior end of soma, terminating some distance anterior to junction of soma and ecsoma. Testes globular, diagonal, separated from ventral sucker by 2–3 uterine coils; anterior testis 175–375×200–360 (261×257); posterior testis 230–370×220–280 (308×256). Seminal vesicle preacetabular, large, bipartite in some, posterior part ovoid 300–400×180–220 (375×200); anterior part about one third size of posterior region, relatively thin-walled, prostatic tube short, entering proximal end of prostate vesicle. Ovary 150–300×125–425 (213×296), one half to two-thirds distance between posterior testis and end of soma. Uterine seminal receptacle present; uterus extending to near posterior level of caeca, as longitudinal and transverse coils filling all space between ovary and posterior level of ventral sucker, entering base of hermaphroditic sac. Vitellaria in two groups of 4 and 3 short digitiform tubes immediately posterior to ovary. Hermaphroditic sac wide, thin-walled, globular; genital atrium ovoid with conspicuous transverse pore. Eggs numerous 17–22×10–12 (18×11).

Remarks. This species was first described by CHAUHAN (1945) from *Arius fulcarius* (Ariidae) and later reported from *Trichiurus* sp. by CHAUHAN (1954) and from *T. haumela* (= *T. lepturus*) by GUPTA and SEHGAL (1971); KARYAKARTE and KULKARNI (1976) described its neurosecretory cells. According to BRAY (pers. comm.), NAMA (1982) considered it a synonym of *L. rufoviridae* (RUD, 1819) LUHE, 1901, a synonymy with which BRAY disagrees. CHAUHAN (1954) and GUPTA and SEHGAL (1971) report the presence of a seminal receptacle, the latter describing the seminal receptacle as “very massive, thick and tripartite”. A true seminal receptacle is not evident in our specimens.

Family: Lecithasteridae ODHNER, 1905

Aponurus laguncula LOOSS, 1907

Synonyms: *Aponurus trachinoti* MANTER, 1940
A. elongatus SIDDIQI et CABLE, 1960
A. waltairensis HUSSAIN, RAO et SHYAMASUNDARI, 1984
Aponurus sp., LINTON (1940)
Lecithophyllum trachinoti (MANTER, 1940) YAMAGUTI,1971

Host: **Siganus oramin* (BLOCH et SCHNEIDER)

Description based on one specimen: Body 1,810×500 just posterior to ventral sucker; forebody 555; hindbody 950. Tegument smooth. Preoral lip small. Oral sucker subterminal, 163 in diameter; ventral sucker 305 in diameter; sucker ratio 1: 1.87. Prepharynx absent; pharynx 87.5 in diameter; esophagus 50; caeca extending to near posterior end of body. Testes almost spherical, diagonal; anterior testis 120 from posterior edge of ventral sucker, 138×130; posterior testis 140×130; seminal vesicle subglobular, 75 in length, closer to pharynx than to anterior edge of ventral sucker; pars prostatica relatively short, surrounded by prostate cells along its length; hermaphroditic sac ovoid, thin-walled, slightly smaller than seminal vesicle. overlapping pars prostatica. Ovary transversely elongate, 80×125; surrounded by 7 vitelline glands. Seminal receptacle 50×75, between anterior vitelline follicles and posterior testis. Uterine coils extending posterior to vitellaria, entering hermaphrodictic sac at its base. Vitelline glands united centrally, ovoid to slightly elongate, three postovarian, three overlapping anterior edge and one at level of ovary; one follicle indented, giving appearance of two for total of eight rather than seven. Eggs few, thin-shelled, 20–25×10–13; characteristic shape as described by BRAY and MACKENZIE (1990) not evident. Genital pore median, near posterior level of pharynx; Excretory system not determined.

Remarks. Our single specimen combines several characteristics seen in several species of *Aponurus* which have been considered synonyms of, or very similar to, *A. laguncula*. Most descriptions and figures show spherical follicles. In our specimen they are ovoid, and in this respect more like *A. elongatus* SIDDIQI et CABLE, 1960 which is considered by BRAY and MACKENZIE (1990) a synonym of *A. laguncula*. Comparing the Kuwaiti material with specimens of *A. elongatus* reported by NAHHAS and SHORT (1965), the vitellarine glands are similar but in body shape and sucker ratio, the Kuwait specimen is typically *A. laguncula*-like. In most descriptions the ovary is usually anterior to the vitellarium whereas in our specimen, the ovary is surrounded by the vitelline follicles. Considering the large number of hosts, at least 60 species of bony fishes in 27 families and 8 orders, according to BRAY and MACKENZIE (1990) such variations are expected. *A laguncula* has been reported by PARUKHIN (1970) from *Therapon jarbua* in the Gulf of Aden and the Red Sea. Several species are known from the Indian Ocean: *A. bengalensis* SRIVASTAVA, 1939 from *Therapon puta*, *A. breviformis* SRIVASTAVA, 1939 also from *T. puta*, *A. orientalis* AHMAD, 1981 from *Therapon theraps* and *A. waltai-*

rensis HUSSAIN, RAO et SHYAMASUNDARI, 1984 from *Acanthurus bleekeri*, considered a synonym of *A. laguncula*. HUSSAIN *et al.* (1984*b*) compared it with *A. laguncula* from which it is distinguished by large seminal vesicle, winding pars prostatica, median posterior testis, and vitelline lobes and seminal receptacle opposite ovary. The only species of *Aponurus* that has been reported from *Siganus* is *A. sigani* ABDUL-AAL, BANAJA et AL-ZANBAGI, 1984 from *Siganus rivulatus* from the Red Sea. *A. sigani* was described from 11 specimens and reported to have 5 vitelline glands.

Lecithaster indicus SRIVASTAVA, 1935
(Fig. 4)

Host: **Otolithes ruber* (SCHNEIDER) (Sciaenidae)

Description based on one specimen: Body elongate, 1,430×390 at ventral sucker; forebody 320; hindbody 910. Tegument smooth. Oral sucker terminal, 82.5×125; prepharynx absent; pharynx 75×80; esophagus absent; caeca wide not reaching posterior end of body, 150 from posterior extremity. Ventral sucker in anterior body third, 200 in diameter. Sucker ratio 1:1.92. Testes symmetrical, right testis elongated (compressed between intestine and right side), 210×90; left testis 137.5×157; seminal vesicle dorsal to ventral sucker ; ovoid, 135×100; pars prostatica 175; hermaphroditic sac ovoid 55×50. Ovary tetralobed, butterfly-shape 150×200 in greatest length and width respectively. Seminal receptacle 100×90, occupying entire space between ovary and right testis; uterus extensive, occupying all spaces between posterior end of body and posterior level of ventral sucker, joining prostatic duct just anterior to ventral sucker. Vitelline glands seven, ovoid-elongate, united centrally, almost contiguous with posterior ovarian lobes. Eggs thin-shelled, 12.5–17.5×8–12. Genital pore, median, at posterior level of pharynx. Excretory vesicle tubular, length and extent of main canals not determined; pore terminal.

Twenty-eight nominal species have been reported in *Lecithaster*, five of which have been described as new from Indian waters: *Lecithaster indicus* from *Clupea ilisha* reported above, *L. extralobatus* SRIVASTAVA, 1935 (five ovarian lobes and eight vitelline glands) from the same host species, *L. chrysophrysi* GUPTA et AHMAD, 1977 (tandem testes, oral sucker larger than ventral sucker) from *Chrysophrys sarba*; *L. allocytii* TKACHUK, 1979 from *Allocytus verrucosus* in the Indian–Southeastern Atlantic; and *L. bombayensis* AHMAD, 1984 (lobed testes) from *Pseudorhombus diacanthus*. We have been unable to obtain information on *L. allocyti*.

L. indicus, first described by SRIVASTAVA (1935), from *Clupea ilisha*, was also recorded by PARUKHIN (1970) from *Anchoviella indica* Gulf of Aden. GUPTA and MIGLANI (1976) redescribed it from an unnamed marine fish and included an illustration. One of the main characteristics of this species is the more anterior lo-

cation of the vitelline glands in relation to the tips of the intestinal caeca. In this feature it resembles, and is considered a synonym of, *L. stellatus* LOOSS, 1907 as figured by BRAY *et al.* (1993*a*). In *L. stellatus*, however, the length of each vitelline gland is 3–4 times the width. Because of our limited material, we prefer, for the time being, to maintain the validity of *L. indicus*. PARUKHIN (1970) also reported *L. confusus* from *Atherina breviceps, A. afra* in the Red Sea.

The normal location of lecithasterids in the host is the intestine. The occurrence of *Aponurus laguncula* and *Lecithaster indicus* in the stomach is probably due to migration after death of their hosts.

Family Bunocotylidae Dollfus, 1950

Aphanurus stossichii (MONTICELLI, 1891) LOOSS, 1907

Synonyms: *Apoblema stossichii* MONTICELLI, 1891
Hemiurus stossichii (MONTICELLI, 1891) Luhe, 1901
Sterrhurus monolecithus SRIVASTAVA, 1941
Aphanurus monolecithus (SRIVASTAVA, 1941) MANTER, 1947
A. harengulae YAMAGUTI, 1938
A. virgula (LOOSS, 1907) MARKEWITSCH, 1952

Hosts: *Sardinella perforata* (Cantor) (Clupeidae)
Ilisha elongata (Bennett) (Clupeidae)
Thryssa whiteheadi Wongratana (Engraulidae)
**Mulloidichthys auriflamma* (Forskal) (Mullidae)

Measurements on specimens from each of the four host species are presented in Table 4.

Description and combined range follow. Body elongate, 385–825×110–250; forbody 70–190; hindbody 225–525. Tegumental plications extending over entire body dorsally and ventrally, more conspicuous on specimens from *Sardinella perforata, Ilisha elongata* and *Mulloidichthys auriflamma* than on those from *Thryssa whiteheadi,* partly due to overflattening. Preoral lip small. Oral sucker subterminal, 30–60×33–70; ventral sucker in anterior body fourth, 60–120 in diameter; sucker ratio 1:1.62–2.54. Prepharynx absent; pharynx 20–40×25–50; esophagus short; caeca wide, extending to near end of body. Testes spherical, diagonal to slightly tandem, contiguous, in midbody third; anterior testis 37–110×29–90; posterior testis 23–120×35–130. Seminal vesicle ovoid, length 1.5–2 times width, as large as or larger than testes, overlapping anterior testis and sometimes junction of testes; prostatic duct long, surrounded by conspicuous cells along its entire length, extending to at least anterior level of ventral sucker, joining uterus to form hermaphroditic duct; hermaphroditic sac somewhat oblong to cylindrical, 2–3 times length of pharynx. Ovary 35–80×40–130, often contiguous with posterior testis. Seminal receptacle absent; uterus extending posteriorly to near end of body, and anteriorly joining prostatic duct near anterior level of ventral sucker. Vitelline gland single, 30–70×45–80, contiguous with, slightly smaller, as large as, or larger than ovary, occasionally indented giving appearance of two overlapping glands; Genital pore near junction of pharynx and oral

sucker. Eggs thin-shelled, numerous, 15–22×11–15. Excretory vesicle tubular, extending to at least junction of testes, arms uniting behind pharynx, pore terminal.

Remarks. Our specimens confirm the synonymy of *A. harengulae* YAMAGUTI, 1938 and *A. virgula* LOOSS, 1907 with *A. stossichii*. GIBSON and BRAY (1979) commented on reports by several investigators with respect to the presence

Table 4. Range and (mean) of *Aphanurus stossichii* from four host species. For abbreviation see Table 2

	Sardinella perforata (37)	*Thryssa whiteheadi* (19)	*Ilisha elongata* (2)	*Mulloidichthys auriflamma* (2)
Body l	400–740	470–825	385–620	450–635
w	125–225	110–250	120–170	125–130
	(603×178)	(633×179)	(503×145)	(543×128)
F'body	80–150	70–190	70–110	112–137
	(121)	(130)	(90)	(125)
H'body	300–480	310–525	240–430	225–423
	(389)	(403)	(335)	(324)
O.S. l	33–60	30–55	40–43	38–55
w	33–60	40–70	40–45	38–40
	(47×50)	(46×50)	(42×43)	(47×39)
V.S. l	80–113	60–120	60–90	88–100
w	70–120	60–110	60–80	75–100
	(101×100)	(97×100)	(75×70)	(94×88)
O.S. : V.S.	1:1.8–1:2.54	1:1.77–1:2.41	1:1.62–1:2.1	1:1.81–1:2.31
	(1:2.08)	(1:2.1)	(1:1.86)	(1:2.06)
Pharynx l	20–40	28–40	25–35	32–35
w	25–40	30–50	25–30	33–36
	(30×35)	(31×36)	(30×28)	(34×35)
A. testis l	37–110	50–80	45–63	38–45
w	29–90	48–90	38–50	35–38
	(56×52)	(61×73)	(54×44)	(42×37)
P. testis l	23–120	45–88	45–48	45–45
w	35–130	40–120	45–53	45–40
	(53×59)	(62×78)	(47×49)	(45×43)
Ovary l	35–80	40–75	50–55	50–78
w	40–130	50–110	45–100	52–75
	(49×77)	(54×82)	(53×73)	(64×64)
Vitellarium l	55–60	50–70	30–55	65–67
w	65–70	60–80	45–63	68–72
	(57×67)	(57×70)	(43×54)	(66×70)
Eggs l	15–18	18–22	15–20	15–18
w	12–15	11–14	11–13	11–14

of a small vestigial ecsoma. None of the Kuwait specimens (in excess of 100 from all hosts) show evidence of such a structure.

RAMADAN (1985) described *Aphanurus pimelopteri* from six specimens recovered from *Pimelopterus tahmel* (Kyphosidae) in the Red Sea and produced a key to identify 11 species of *Aphanurus*. Several of the species listed in the key (*A. monolecithus, A. harengulae, A. virgula*) are considered synonyms of *A. stossichii*. HUSSAIN *et al.* (1984*a*) described *A. dussumieri* from four specimens recovered from *Dussumieria hasseletii* (Clupeidae) from Waltair coast, Bay of Bengal which they compared with *A. harengulae* and *A. stossichii* distinguishing it from the former by a larger ovary compared with the testes, the length of the seminal vesicle and absence of body folds and from the latter by a larger sucker ratio of 1:3.5. The Kuwaiti specimens from fishes of different families (Clupeidae, Engraulidae, and Mullidae) show remarkable similarities in topography of organs and overlapping measurements. Our observations and measurements (Table 4) suggest that relative size of the vitellarium, the ovary and the testes are not reliable species characteristics. *A. dussumieri* seems to differ only in its larger sucker ratio.

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A REVISION OF THE ORIENTAL PTECTICUS SPECIES DESCRIBED BY G. ENDERLEIN (STRATIOMYIDAE, DIPTERA)

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Six Oriental species of the genus *Ptecticus* Loew described by Enderlein (1914) are revised. Only one of them (*Gongrozus vulpianus*) was recently elucidated as a valid species being conspecific with *P. rectinervis* de Meijere (cf. Rozkošný & de Jong 2001). Two of them (*P. sumatranus* and *P. violaceous*) are confirmed as valid species and their identity is documented by the detailed redescriptions and illustrations of the male terminalia. Three species are interpreted as definitive synonyms of other species: *Gongrozus nodivena* and *G. nodivena* var. *striginotum* are new junior synonyms of *P. longipennis* (Wiedemann, 1824), *P. ochraceus* is a new junior synonym of *P. melanurus* (Walker, 1848), and *G. sauteri* is proved to be a junior synonym of *P. aurifer* (Walker, 1856). Lectotypes are designated for *P. aurifer* (Walker), *P. longipennis* (Wiedemann), *P. melanurus* (Walker) and *P. violaceus* Enderlein. Taxonomic and distributional notes are added to each species treated.

Key words: *Ptecticus*, new synonyms, lectotypes, taxonomy, distribution

INTRODUCTION

In 1914 Enderlein described three new species in the genus *Ptecticus* Loew, 1855 and three new species in a newly created genus *Gongrozus*. Both genera were distinguished only by the presence (*Ptecticus*) or absence (*Gongrozus*) of the posterior crossvein. However, this character has appeared to be fairly variable in some species and, moreover, it is mostly not correlated with some more significant features. Thus, the genus *Gongrozus* has not been accepted by subsequent authors and is considered a mere synonym of *Ptecticus* (see James 1975, Woodley 2001).

The type specimens of the Enderlein's species are deposited in the Zoological Institute of the Polish Academy of Sciences (PAN). They are in fairly good condition and most of them were re-examined in detail. The type specimens of the other species studied are deposited in the Natural History Museum, London (BMNH) and Zoological Museum, Copenhagen (ZMC).

SYSTEMATIC ACCOUNT

Ptecticus aurifer (WALKER, 1854)

Sargus aurifer WALKER, 1854: 96.
Gongrozus sauteri ENDERLEIN 1914: 586, **syn. nov.**

Type specimens: Syntypes of *Sargus aurifer*: 2 ♂♂. Lectotype: ♂ labelled: /N. China, W. H. Balés, purchased Stevens, 52.14/, /Syntype *Sargus aurifer* Walker, det. J. E. Chainey 1982/, in BMNH. Designated as lectotype herewith and labelled adequately.

Paralectotype ♂ labelled: /India ex coll. W. W. Saunder, 54.13/, / Syntype *Sargus aurifer* Walker, det. J. E. Chainey 1982/, /Type (on a round label with a green margin)/.

Holotype of *Gongrozus sauteri*: ♂ labelled: /Formosa, Kosempo, 23.i.08. H. Sauter/, /, /Type (red label)/, /*Gongrozus sauteri* Type Enderl. ♂ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/45 /, /*sauteri* Enderl. 1914/, in PAN.

Diagnosis: A large yellow species with conspicuously bicoloured wings. Legs usually yellow, body pubescence golden yellow, abdominal tergites darkened in variable extent, terminalia yellowish brown with yellow hairs.

Description ♂: Head yellow, only ocellar triangle blackish and frontal callus whitish, postocular area dark. Upper frons tapered towards frontal callus, narrower than anterior ocellus at narrowest point. Frontal callus broad and relatively low in profile, distinctly less high than depth of fore tibia in the middle. Antenna yellow, pedicel with usual subtriangular inner projection, flagellomeral complex higher than long, slightly concave distally, arista darkened in distal two-thirds. Head pubescence golden yellow, rather long and erect, very dense and appressed only on postocular area.

Thorax shining yellow, only scutum, scutellum and mediotergite slightly more brownish. Thoracic pile yellow, longer only above fore coxa, on laterotergites and lower half of mediotergite.

Wings bright orange in basal two-thirds and brownish to blackish in apical third, with somewhat less darkened broad lower margin. Vein R_{2+3} arising at anterior crossvein, slightly shorter than R_s, upper proximal margin of discal cell distinctly arched. All M veins (except for straight M_2) finely sinuate. Posterior crossvein well developed, about half as long as anterior one. Postcubital vein well visible and pigmented. Halter yellow with darkened knob, posttegula with dark brown hairs.

Legs usually ochre yellow, rarely distal half of hind tibia and hind tarsi somewhat more brownish, only tips of claws blackish. Tibia-basitarsal index (length of fore tibia divided by length of fore basitarsus) 1.75–1.79. Pubescence on legs chiefly short, semi-appressed and dense.

Abdomen coloration variable, predominantly ochre yellow to brown, rarely with distinct darker transverse bands on tergites but more often with diffuse and extensive darkening occupying tergites 2–5. Venter usually with sternites 1–3 yellow and sternites 4–6 darkened. Apical segments always yellowish brown. Abdominal pubescence chiefly golden yellow and appressed, longer and erect only laterally at base. Tergites with extensive additional short black hairs but apical segments only with golden yellow hairs. Male terminalia (see NAGATOMI 1975, Figs 8–9) with transverse, simple epandrium, without surstyli. Synsternite subquadrate, of plesiomorphic type, i.e. without any projections on gonocoxites, gonostylus simple, slightly curved inwardly, with a blunt tip, aedeagus tube-like.

♀ as in male but with broader frons and different abdominal terminalia. Frontal index (length of upper frons from upper margin of frontal callus to anterior ocellus divided by the minimum width of frons) 5.7–6.0. Tibia-basitarsal index (see above) usually lower than in male, about 1.58. Terminalia also yellowish brown and golden yellow haired, cerci long, distal segment distinctly shorter than proximal one.

Length: body 12.0–23.0 mm, wing 10.5–21.0 mm.

Taxonomic notes: *P. aurifer* is a typical member of the species group with the same name which is characterized by vein R_{2+3} being short (shorter than R_s), a well developed postcubital vein and conspicuously bicoloured (orange and blackish) wings. Relatively detailed descriptions have been published by KERTÉSZ (1909) and NAGATOMI (1975), whereas BRUNNETTI's (1920) description under this name actually refers to the related *P. melanurus* (WALKER). KERTÉSZ (l. c.) discussed a series of specimens from Taiwan (Formosa) compared with WALKER's types. The synonym pointed out above was suspected by JAMES (1975) and is fully confirmed by the present study of the type specimens of both species under discussion. WALKER (1854) did not specify the number of type specimens but mentioned both sexes though only 2 males (from both original type localities) are preserved in BMNH. There is no doubt that both syntypic males are conspecific. The male from China (explicitly pointed out by WALKER) is designated as lectotype here because it belongs to the apparently more widely distributed form with extensive diffuse dark markings on tergites 3–5, and purely yellow hind legs. The second syntypic male originates from "India" (according to the original label) and it is probably the same specimen mentioned by WALKER (1854) from "Hindostan". It possesses partly darkened hind legs that are almost brown in the distal half of the hind tibia and the whole hind tarsus.

Distribution: A widely distributed species known to occur in the eastern part of the Palaearctic Region (Far East of Russia, China, Japan) and probably the entire Oriental region (India, West and East Malaysia, Singapore, Vietnam and Taiwan, Indonesia: Kalimantan).

Ptecticus longipennis (WIEDEMANN, 1824)
(Figs 1–4)

Sargus longipennis WIEDEMANN, 1824: 31
Gongrozus nodivena ENDERLEIN, 1914: 585, **syn. nov.**
Gongrozus nodivena var. *strigonotum* ENDERLEIN, 1914: 586, **syn. nov.**

Type specimens: Syntypes of *Sargus longipennis*: 2♂♂. Lectotype ♂ labelled: /*S. longipennis* Wied., Java, May 1815 (in WESTERMANN's handwriting)/, /♂/, /Mus. Westerm./, /TYPE (red label)/, in ZMC. Designated as lectotype here and labelled adequately.

Paralectotype ♂ labelled: /Mus. Westerm./ and /TYPE (red label)/; it is also preserved in ZMC.

Syntypes of *Gongrozus nodivena*: 2 ♂♂ and 2 ♀♀.

Lectotype: ♂ labelled: /Dohr, Sumatra, Soekaranda/, Type (red label)/, /*Gongrozus nodivena*, Type Enderl. ♂ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/45 /, /*nodivena* Enderl. 1914/, in PAN. Designated as lectotype of *Gongrosus nodivena* Enderlein, 1914 here and adequately labelled.

Paralectotype: ♀ labelled: /Dohr, Sumatra, Langagas/, /Type (red label)/, /*Gongrozus nodivena*, Type Enderl. ♀ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/ 45 /, in PAN.

Further syntypic ♂ and ♀ from Sumatra, Soekaranda, were not examined.

Holotype of *Gongrozus nodivena* var. *strigonotum*: ♂ labelled: / Dohr, Sumatra, Soekaranda/, /Type (red label)/, /*Gongrozus nodivena* END. var. *striginotum*, Type Enderl. ♂ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/45 /, /var. *striginotum* Enderl. 1914/, in PAN.

Diagnosis: Upper frons, vertex and occiput subshining black, scutum predominantly shining metallic blue, wings darkened apically, abdomen black with yellow pattern. Medial process of male synsternite slender, consisting of two rodlike and pointed projections.

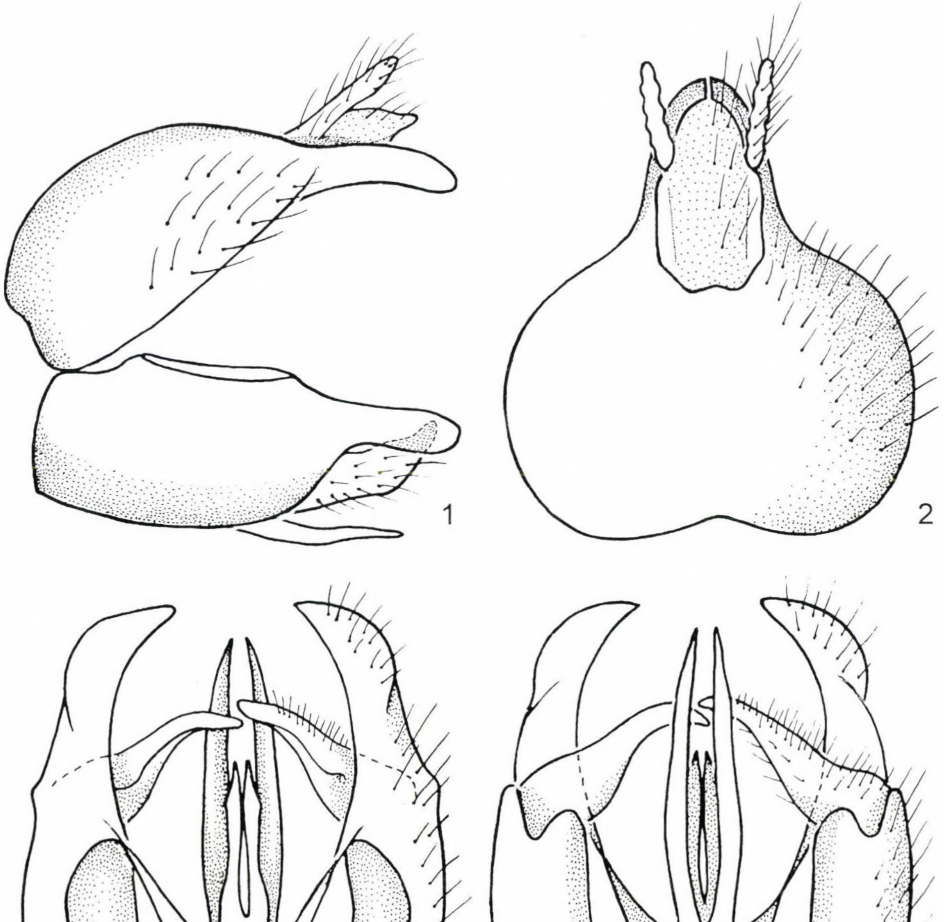
Description ♂ and ♀: Redescribed recently by ROZKOŠNÝ and KOVAC (1994). Tibia-basitarsal index 1.16 –1.20 in males and 1.33–1.37 in females, female frontal index about 4.0. Male terminalia species-specific (Figs 1–4), with very characteristic, long, paired medial processes on the ventral side of the hypopygium visible even in situ (i.e. in undissected specimens).

Taxonomic notes: The extent of the dark pattern on the thorax seems to be quite variable in both sexes. The dark forms show the scutum predominantly black with only the humeral and postalar calli and subtriangular posthumeral spots yellow and also the pleural yellow pattern is limited (narrow subnotopleural stripe, upper hind corner of katepisternum and posterior half of anepimeron). In pale forms (especially some females), the scutal darkening is reduced to diffuse lateral (notopleural) longitudinal stripes and a dark midline. In the pleural area the lower pleura, anepimeron and laterotergites are entirely yellow. The male abdomen can usually be described as yellow with transverse black bands on the tergites. Rarely the black and often the metallic shining areas are considerably extended leaving only very small spots on the extreme posterior corners of the tergites yellow (see a male from Indonesia: Sumba in ROZKOŠNÝ & KOVAC 2002).

Data on the syntypes of *P. longipennis* were kindly provided by V. MICHELSEN (e-mail from 14 Aug 2001). WIEDEMANN (1824) noted only "Iava" as the type locality and "In museo Westermanni" for the deposition of the type specimens but he did not specify the number of specimens originally studied. In the WESTERMANN Collection (Copenhagen) there are two males in excellent condi-

tion, both being conspecific and corresponding with the present concept of this species. There is no doubt that *P. longipennis* and *P. nodivena* are conspecific. *P. nodivena* var. *striginotum* is based on a specimen of the pale form of the female.

Distribution: Widely distributed from India through West and East Malaysia, Singapore and Indonesia (Sumatra, Pulau Simeulue, Java, Kalimantan) to the Philippines.



Figs 1–4. *Ptecticus longipennis*: male terminalia 1 = lateral view, 2 = epandrium, proctiger and cerci; 3–4 = synsternite, gonostyli and aedeagal complex in dorsal and ventral view

Ptecticus melanurus (WALKER, 1848)

Ctenophora melanura WALKER, 1848: 78.
Ptecticus ochraceus ENDERLEIN, 1914: 582, **syn. nov.**

Type specimens: Syntypes of *Ctenophora melanura*: 2 ♂♂. Lectotype ♂ labelled: /*Ctenophora melanura* Walker, type/, /Hardwicke Bequest/, /One of Walker's series so named Edw./, /Type (round label with green margin)/, /Syntype *Ctenophora melanura* Walker, det. J. E. Chainey 1982/. Head missing and posterior margin of wing partly damaged. Male terminalia mounted in Canada balsam. This specimen is designated here as lectotype and labelled adequately.

Paralectotype ♂ labelled: /Hardwicke Bequest/, /One of Walker´s series so named Edw./, /Type (round label with green margin)/, /Syntype *Ctenophora melanura* Walker, det. J. E. Chainey 1982/. Head and left fore leg (except coxa and femur) missing.

Holotype of *Ptecticus ochraceus*: ♀ labelled: /Darjeeling, Sikkim, H. Rolle, Berlin, S.W. 11/, /Type (red label)/, /*Ptecticus ochraceus*, Type Enderl. ♂ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/45 /, /ochraceus Enderl. 1914/, in PAN.

Diagnosis: A predominantly yellow species with conspicuously bicoloured (orange and blackish) wings. Apical darkening reaching discal cell or nearly so. Basal part of abdomen orange, apical third black and black haired.

Description ♂: Similar to *P. aurifer* with the following distinguishing characters: Male frons narrower than in *P. aurifer*, often about half as broad as anterior ocellus at narrowest point, distal margin of flagellar complex rather transverse instead of slightly concave. Wing venation of same type but apical darkening of wing more extensive, usually reaching anterior crossvein and distal margin of discal cell or closely approximate to them. Hind legs usually darkened: hind tibia (or at least its distal half) and whole hind tarsus dark brown and densely brown haired, only brush-like ventral pubescence of tarsomeres more orange. Basal 4 abdominal segments usually bright orange and rest of abdomen contrastingly black and black haired. Male terminalia similar to those of *P. aurifer*, with no reliable differences found.

Description ♀: As in male but with broader frons and different terminalia. Frontal index 6.10–6.25, tibia-basitarsal index 1.60–1.67. Female terminalia as deep black and black haired as in male, apical segment of cerci slender and shorter than proximal one.

Length: body 10.8–22.0 mm, wing 11.0–17.3 mm.

Taxonomic notes: Differences in the wing darkening between *P. aurifer* and *P. melanurus* seem to be sufficiently reliable (at least in about 30 examined specimens of both species). Also the coloration of the abdomen and legs is mostly characteristic for both species but much more variable. The bright orange basal part of the abdomen is by far prevalent in most specimens though some show dark markings on both sides of segment 4. Rarely the abdomen can be predominantly brown as in *P. aurifer* but also in these specimens, the abdominal apex from segment 5 is black and black haired. The hind tibia and tarsus are as a rule at least partly brown and brown haired. Seldom is this darkening only slightly visible. The male terminalia of both species are different at first glance: pale and golden yellow haired in

P. aurifer and blackish and black haired in *P. melanurus*. On the other hand, no reliable structural differences were found. Only a certain tendency to asymmetry was found in some males of *P. melanurus* but this feature is not found in all specimens. In such specimens, the right proximal corner of the epandrium is slightly elongated and the synsternite is somewhat oblique, not rectangular.

Distribution: India, West Pakistan, Nepal, Thailand, West and East Malaysia, Singapore and Indonesia (Sumatra, Kalimantan).

Ptecticus sumatranus ENDERLEIN, 1914 (Figs 5–8)

Ptecticus sumatranus ENDERLEIN, 1914: 583.

Holotype: ♂ labelled: /Dohrn, Sumatra, Soekaranda/, /, /Type (red label)/, /*Gongrozus nodivena*, Type Enderl. ♂ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/45/, /*nodivena* Enderl. 1914/, in PAN.

Diagnosis: A species from the *P. longipennis* group with darkened wing apices, a straight vein M_3 that is parallel to M_2, indistinct postcubitus and transversely yellow and black banded abdomen. In contrast to *P. longipennis,* the inner projection of the pedicel is reduced and the thorax is entirely shining yellow.

Description: ♂ (holotype): Head semiglobular, frontal callus nasiform in lateral view, markedly prominent, about twice as long as distal diameter of fore tibia. Upper frons, ocellar triangle, vertex and entire occiput shining black, frontal callus elongated guttiform in dorsal view and whitish yellow; antennae, face and proboscis yellow. Pedicel only slightly arched on distal inner margin, without usual subtriangular inner projection. Flagellar complex compressed, about twice as high as long, nearly transverse distally, arista brownish. Head pubescence mostly erect and moderately long, entirely yellowish including that of frons and both basal antennal segments. Upper postocular area with erect short pale hairs and appressed dense dark pubescence.

Thorax wholly shining yellow and yellow haired. Thoracic hairs long and erect especially above fore coxa, on anterior half of scutum, on laterotergites and mediotergite, semi-erect and shorter on posterior half of scutum and scutellum.

Wing resembling *P. longipennis,* hyaline, with darkened apical part beginning distinctly before midpoint between discal cell and wing tip. Cell R brownish, R_{2+3} starting at anterior crossvein, distinctly longer than R_s and slightly converging to R_1. Anterior crossvein relatively long, upper proximal margin of discal cell barely arched, posterior crossvein about half as long as anterior one, M_3 straight and parallel to M_2, its apical fourth missing. Postcubitus very hyaline, virtually indistinct. Halter yellowish with darkened apical half, posttegula with tuft of brownish hairs.

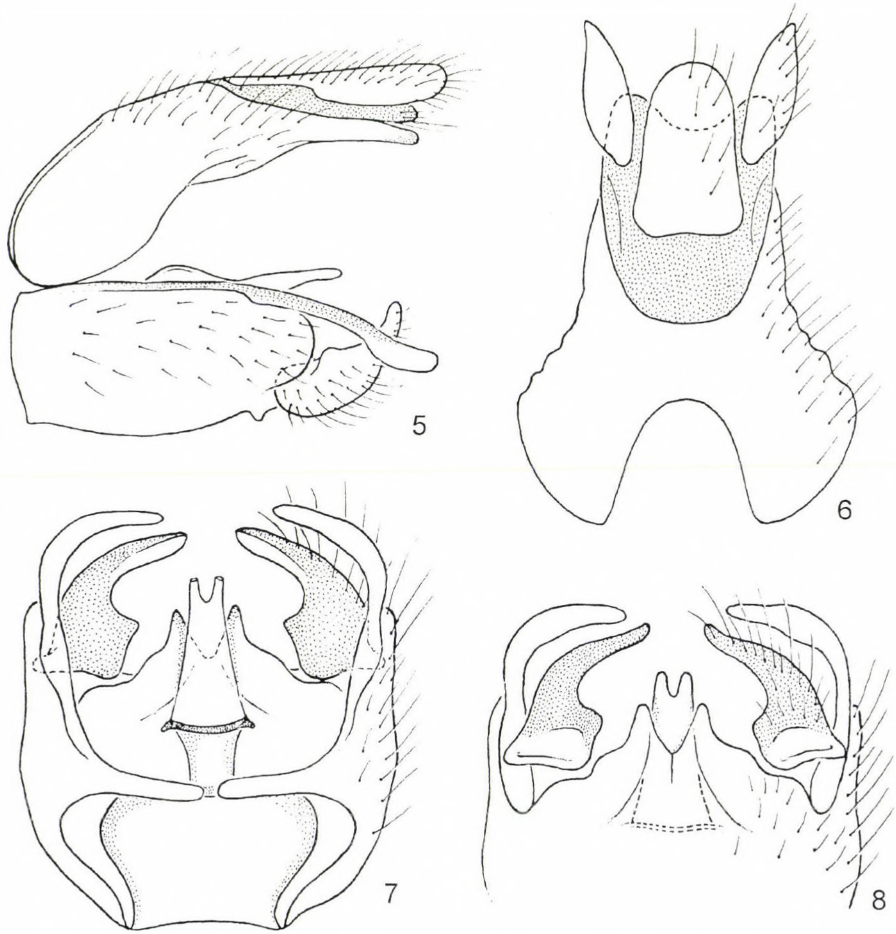
Legs entirely yellow, only hind tibia dark brown. Tibia-basitarsal index (fore leg) 1.28. Hind tarsi missing but whitish according to ENDERLEIN (except for extreme base of basitarsus). Last three tarsomeres of fore leg somewhat brownish, with dark pubescence on dorsal surface.

Abdomen yellow, with transverse black bands on tergites. Tergite 1 predominantly dark, bands on tergites 2–4 occupying less than anterior half of each tergite and leaving the narrow anterior

margin also yellow, following tergites mostly dark. Abdominal venter yellow, posterior half of sternite 5 dark, terminalia blackish. Abdominal pubescence long, erect and yellowish on sides of basal half, predominantly short, black and appressed on tergites and short, yellow and semi-appressed on sternites. Terminalia (Figs 5–8): epandrium fused with paraprocts and deeply emarginate proximally; each gonocoxite with a long, slender, incurved posterodorsal process; medial process of synsternite prominent, with subtriangular medial incision on posterior margin; gonostylus relatively narrow but enlarged in basal part; aedeagal complex simply tube-like, bifid apically.

Length: body 7.9 mm, wing 9.0 mm (ENDERLEIN: 7.4 mm and 9.5 mm).

Taxonomic notes: A relatively small species of the *P. longipennis* group is characterized by the darkened wing apex but differing from the most *Ptecticus* spe-



Figs 5–8. *Ptecticus sumatranus*: male terminalia 5 = lateral view, 6 = epandrium, proctiger and cerci, 7–8 = synsternite, gonostyli and aedeagal complex in dorsal and ventral view

cies (except for *P. minimus* ROZKOŠNÝ et KOVAC, 1997) by the absence of a subtriangular inner projection of the pedicel. Surprisingly, structures of the male terminalia indicate a distinct relationship to *P. violaceus* though the epandrium differs by the deep proximal emargination, the posterolateral projections of the gonocoxites, the diststyli are much more slender, and the medial process of the synsternite as well as the aedeagal complex display distinct differences.

Distribution: Indonesia (Sumatra).

Ptecticus violaceus ENDERLEIN, 1914
(Figs 9–12)

Ptecticus violaceus ENDERLEIN, 1914: 582.

Lectotype: ♂ labelled: /Dohrn, Sumatra, Deli/, /Type (red label)/, /*Ptecticus violaceus*, Type Enderl. ♂ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/45/, /*violaceus* Enderl. 1914/, in PAN. Designated as lectotype of *Ptecticus violaceus* ENDERLEIN, 1914 here and adequately labelled.

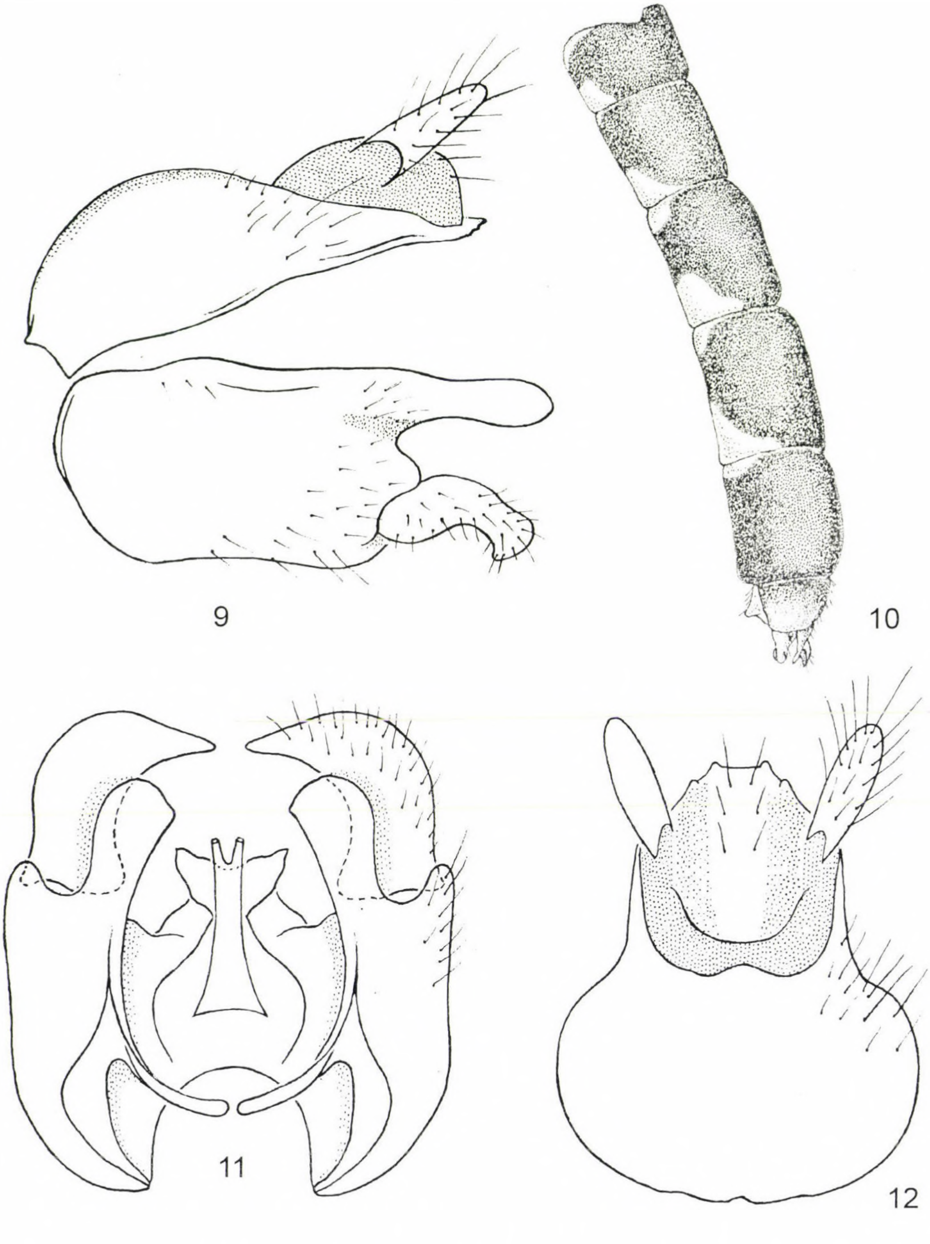
A further syntypic ♂ from now paralectotype from Sumatra, Soekaranda, was not examined.

Diagnosis: A species from the *P. longipennis* group with a shining metallic blue scutum, darkened wing apices, a straight vein M_3 that is parallel to M_2, indistinct postcubitus, and a limited yellow pattern on the abdominal tergites (Fig. 10). This species is much larger than *P. sumatranus*.

Description: ♂ (lectotype): Head semiglobular, frontal callus rounded but prominent in lateral view, slightly higher than maximum diameter of fore tibia. Upper frons, ocellar triangle, vertex and entire occiput shining black, frontal callus guttiform (in dorsal view) and whitish yellow, antennae, face and proboscis yellow. Pedicel with usual subtriangular inner projection, flagellar complex compressed, much higher than long, arista brownish. Head pubescence mostly erect and moderately long, black from upper frons to vertex, yellow on face and above antennae, dark brown on basal antennal segments. Upper postocular area with erect long hairs and short dense appressed hairs.

Thorax shining black, with metallic reflections on scutum, scutellum, mediotergite and lower part of katepisternum. Humeral calli yellow, postalar calli yellowish brown and posterior margin of scutellum broadly brownish. Pleura chiefly brown to black, only subnotopleural stripe (as broad as maximum depth of fore femur) and oval spot in upper posterior corner of katepisternum contrastingly yellow. Posterior half of anepisternum, anepimeron and laterotergites brown rather than black. Thoracic pubescence yellowish, mostly inconspicuous, longer on humeral calli, anterior margin of scutum, above fore coxa, on laterotergites and mediotergite.

Wing slightly yellowish infuscated, with darkened apical part beginning slightly proximal to midpoint between discal cell and wing tip. Cell R brownish, R_{2+3} arising slightly before anterior crossvein, distinctly longer than R_s. Anterior crossvein relatively long, upper proximal margin of discal cell slightly arched, posterior crossvein very short, M_3 straight and parallel to M_2, its apical sixth missing. Postcubitus unpigmented, developed only as a hyaline wing fold. Halter yellowish with darkened club, posttegula with tuft of yellowish hairs.



Figs 9–12. *Ptecticus violaceus*: male characters 9 = terminalia in lateral view, 10 = abdomen in dorsolateral view, 11 = synsternite, gonostyli and aedeagal complex in dorsal view, 12 = epandrium, proctiger and cerci

Legs predominantly yellow, only entire hind tibia and nearly the basal half of hind basitarsus dark brown and brown haired. Rest of hind tarsus white and whitish haired. Last three tarsomeres of fore and mid tarsi slightly darkened. Tibia-basitarsal index (fore leg) 1.72.

Abdominal dorsum shining black, only broad subtriangular posterior corners and small anterior corners of tergites yellow (Fig. 10). Venter yellow, with transverse black bands on sternites becoming broader towards abdominal apex but markedly reduced on sternite 3 where only subtriangular lateral spots are present. Abdominal pubescence mostly pale yellow, long and erect at base and on sides, shorter and semi-erect ventrally, but very short, appressed and mostly black on tergites. Male terminalia (Figs 9, 11–12) differing markedly from the related *P. longipennis*. Proctiger relatively larger and epandrium also fused with paraprocts. Posterodorsal processes of gonocoxites shorter and stouter, gonostyli much broader in dorsal view. Medial process of synsternite simple, bicuspidate, with shallow emargination distally. Aedeagal complex short, simple and bifid apically.

Length: body 13.7 mm (12.5–13.0 in ENDERLEIN), wing 17.8 mm (15.5–17.0 mm in ENDERLEIN).

Taxonomic notes: This species is externally very similar to *P. longipennis* though the abdomen appears to be much darker. However, rarely the abdominal yellow pattern may be considerably reduced in *P. longipennis* as well and then the male terminalia exhibit a unique complex of distinguishing characters. The characteristic medial process of the synsternite may be easily examined in the males of both species even without any preparation since the genitalia are frequently partly exposed.

Distribution: Indonesia (Sumatra, Deli).

Ptecticus vulpianus (ENDERLEIN, 1914)

Gongrozus vulpianus ENDERLEIN, 1914: 586.

Type specimens: Lectotype of *P. vulpianus* (ENDERLEIN): ♂, labelled: /Dohr, Sumatra, Soekaranda/, /Type (red label)/, /*Gongrozus vulpianus*, Type Enderl. ♂ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/45/, /*vulpianus* Enderl. 1914/, in PAN. Designated as lectotype of *Gongrozus vulpianus* ENDERLEIN by ROZKOŠNÝ & DE JONG (2001).

Paralectotype ♀ labelled: /Dohr, Sumatra, Soekaranda/, /Type (red label)/, /*Gongrozus vulpianus*, Type Enderl. ♀ (in ENDERLEIN's handwriting), Dr. Enderlein det. 1914/, /Mus. Zool. Polonicum, Warszawa, 12/45/, in PAN. This specimen differs from the other females examined of *P. vulpianus* (the characteristic dark spot on the lower side of the frontal callus is missing, the apical abdominal segments are partly yellow) and it is thus probably not conspecific with the male lectotype.

Three additional syntypic ♂♂ and 2 syntypic ♀♀ were not examined.

Diagnosis: The lower part of the frontal callus is darkened and all dark transverse bands on the abdomen reach the margins of tergites. Related to *P. australis* SCHINER but usually with brownish basal 1/2–2/3 of hind femur on outer side and without any surstyli on the epandrium in males.

Description ♂ and ♀: This species was redescribed recently by ROZKOŠNÝ & DE JONG (2001) who proved that *P. rectinervis* DE MEIJERE, 1914 is a junior synonym of *P. vulpianus*.

Taxonomic notes: *P. vulpianus* undoubtedly belongs to the *P. australis* group characterized by the black upper frons and vertex, the yellow thorax, straight vein M_3 being parallel to M_2, the indistinct postcubitus, the transversely banded abdomen and the dark hind tibia and base of the hind basitarsus. From related species it differs by the markedly darkened lower half of the frontal callus in both sexes. Moreover, the males possess no surstyli on the epandrium (surstyli present in *P. australis* SCHINER, 1868 and *P. srilankai* ROZKOŠNÝ et HAUSER, 2001) and the aedeagal complex is bifid apically and not trifid (as in *P. subaustralis* ROZKOŠNÝ et KOVAC, 1998).

Distribution: India, West Malaysia, Indonesia (Sumatra, Java).

*

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NEW SPECIES AND RECORDS OF THE AXARUS "ROGERSI-GROUP" FROM SOUTH AND CENTRAL AMERICA (DIPTERA, CHIRONOMIDAE)

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Axarus froehlichi sp. n. from the Minas Gerais State in Brazil is described and figured as male imago. New records of *Axarus rogersi* (BECK et BECK) from Mexico and Costa Rica are given.

Key words: Chironomidae, *Axarus*, new species, Brazil, Costa Rica, Mexico

INTRODUCTION

The genus *Anceus* was erected by ROBACK (1963) as a subgenus of *Xenochironomus* KIEFFER. The name *Axarus* was introduced by ROBACK (1980) as a replacement name for *Anceus*, which was preoccupied. The genus is known from the Holarctic, Neotropical and Australasian regions (CRANSTON *et al.* 1989). In their recent checklist, SPIES and REISS (1996) listed two species of *Axarus* from the Neotropical region, namely *A. ochros* (WALLEY *in* CURRAN, 1934), from the Guyana and *A. rogersi* (BECK et BECK, 1958) from Costa Rica and Nicaragua, the latter also being distributed in southeastern USA (OLIVER *et al.* 1990). In addition, TOWNES (1945) based his redescription of *A. dorneri* (MALLOCH, 1915) on a male from Barro Colorado Island in Panama. *A. dorneri* was described by MALLOCH (1915) as female only, and TOWNES (1945) stated that he could not be sure that the male he described and figured is MALLOCH's *dorneri,* but that the specimen was the only available male which could possibly be *A. dorneri.*

The larva of *Axarus* is found in the littoral and sublittoral zone of lakes and rivers, where they live in soft sediments like mud and clay. FERRINGTON (1992) studied the habitat and sediment preferences of *A. festivus* (SAY, 1823) larvae from a reservoir in northeast Kansas, USA.

ROBACK (1963) split the genus into two species groups, the *festivus*-group and the *rogersi*-group, mainly based on differences in the shape of tergite IX and the anal point, and assigned two species to the *rogersi*-group, namely *A. rogersi*

and *A. dorneri*. However, as pointed out by PINDER and REISS (1983) these species groups are not supported by the larvae.

In the present paper we describe a new *Axarus* species from southern Brazil possessing a modified anal point, and give new records of *A. rogersi* from Mexico and Costa Rica.

MATERIAL AND METHODS

The material examined was mounted on slides in Canada balsam following the procedures outlined by SÆTHER (1969). The general terminology follows SÆTHER (1980). Measurements are given as ranges followed by the mean when four or more measurements are made, and by the number of individuals (n) in parenthesis.

Type material is deposited in the Museum of Zoology, University of Bergen, Norway (ZMBN); and paratypes in the Zoologisches Staatssammlung München (ZSM); the Fundação Instituto Oswaldo Cruz (FIOCruz), Rio de Janeiro, Brazil, Universidade Federal de São Carlos (UFSCar), São Carlos, Brazil; the Museu de Zoologia da Universidade de São Paulo (MZUSP), São Paulo, Brazil.

SYSTEMATIC PART

Axarus froehlichi sp. n.
(Figs 1–5)

Holotype: male, Brazil, Minas Gerais State, Santa Rita de Cássia, 20°51'S, 46°58'W, 18. June 2000, light trap, H. F. MENDES, (ZMBN type No.: 359, slide-mounted in Canada balsam).

Paratypes: 10 males, as holotype (4 males ZMBN, 3 males ZSM, 1 male MZUSP, 1 male FIOCruz, 1 male UFSCar).

Diagnostic characters: This species groups with *A. dorneri* and *A. rogersi* by having a modified anal point. However, the shape of the anal point, with two rounded lateral, setose lobes medially and the large subtriangular setose lobes on tergite IX, laterally to the base of the anal point easily separate *A. froehlichi* sp. n. from the two other species. The species can also be separated by its larger size, and by the wider, more rounded gonostylus.

Etymology: Named in honour of Professor Dr. CLAUDIO GILBERTO FROEHLICH, for all his support and kindness.

Description: Male imago (n = 8 except when otherwise stated). – Total length 8.53–9.04, 8.77 mm. Wing length 3.81–4.06, 3.89 mm. Total length / wing length 2.23–2.27, 2.25. Wing length / length of profemur 2.06–2.23, 2.15. Head, abdomen and legs brown, thorax light brown.

Head. AR 3.90–4.24, 4.11. Antenna with 11 segments; ultimate flagellomere 1.68–1.83, 1.79 mm long. Temporal setae 27–32, 29, uniserial. Clypeus with 33–54, 40 setae. Tentorium, stipes and cibarial pump as in Figure 1. Tentorium 228–248, 239 µm long; stipes 272–304, 293 µm long. Palp segment lengths (in µm) (n=7): 84–92, 86; 96–100, 98; 308–368, 333; 272–308, 291; 348–716, 379. Apex of third palpomere with 5–7 sensilla laterally, longest 25–34, 29 µm long.

Thorax (Fig. 2). Dorsocentrals 9–16, 12; prealars 4–6, 5; acrostichals 10–16, 13. Scutellum with 9–11, 10 setae.

Wing (Fig. 3). VR 1.08–1.15, 1.12. Brachiolum with 1–2, 2 setae; R with 37–44, 41; R_1 with 23–32, 28; R_{4+5} with 31–39, 33 setae. Squama with 4–8, 7 setae.

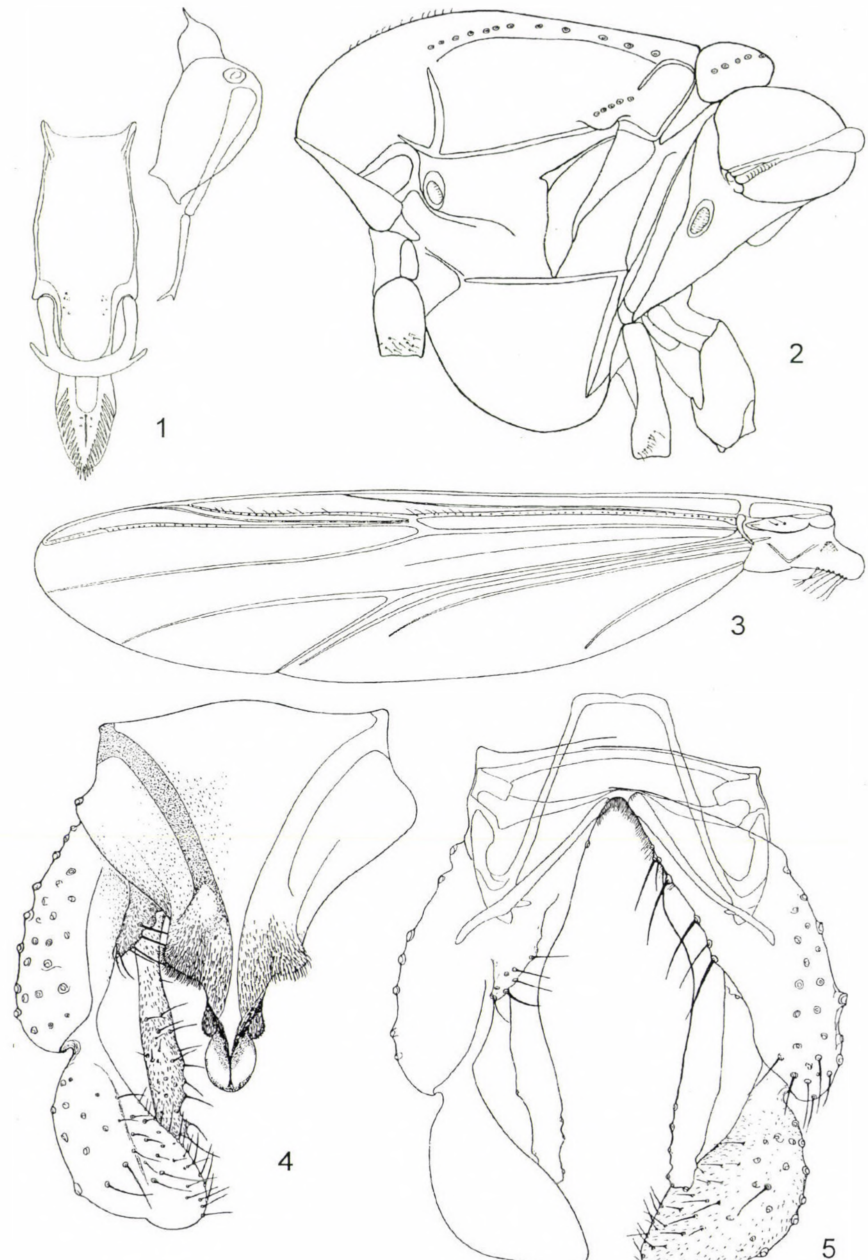
Legs. Scale of front tibia 63–72, 67 (7) µm long, spurs of middle tibia 84–94, 90 (6) µm and 59–66, 62 (7) µm long; spurs of hind tibia 96–115, 102 (5) µm and 63–72, 66 (5) µm long. Apex of fore tibia 113–123, 117 µm wide; of mid tibia 113–117, 116 (7) µm wide; of hind tibiae 123–129, 125 (5) µm wide. Pseudospurs of midleg: ta_1 69–76, 73 (6) and 61–74, 68 (3) µm long; ta_2 65–74, 70 (6) and 67–72, 69 (5) µm long; ta_3 65–72, 67 (5) and 61–65, 64 (5) µm long. Pseudospurs on hind leg: ta_1 84–92, 89 (3) and 80–90, 86 (4) µm long; ta_2 82–88, 85 (4) and 80–86, 83 (4) µm long; ta_3 80 (1) and 69–72 (2) µm long. Length and proportions of legs, in µm (n = 5–7):

	fe	ti	ta_1	ta_2
P_1	1730–1934, 1815	1504–1669, 1584	2307–2431, 2390	845–865, 858
P_2	1792–1978, 1875	1648–1772, 1710	968–1112, 1027	391–433, 409
P_3	2184–2369, 2295	2019–2204, 2097	1421–1504, 1438	639–680, 651
	ta_3	ta_4	ta_5	
P_1	1051–1092, 1092	1071–1174, 1106	330–391, 367	
P_2	288–330, 315	185–227, 209	103–124, 121	
P_3	371–597, 470	227–309, 284	124–165, 157	
	LR	BV	SV	BR
P_1	1.37–1.65, 1.48	1.67–1.78, 1.71	1.38–1.52, 1.45	5.52–5.53(3)
P_2	0.57–0.63, 0.60	4.04–4.73, 4.38	3.28–3.68, 3.49	2.50–2.80, 2.65
P_3	0.65–0.73, 0.69	3.48–3.88, 3.69	2.93–3.17, 3.05	5.00–5.27, 5.11(4)

Hypopygium (Figs 4 – 5). Anal point 136–164, 154 µm long, 124–144, 135 µm wide at base and 48–56, 51 µm wide at apex; with lateral, rounded, setose lobes medially. Posterior margin of tergite IX with large, subtriangular, setose lobes laterally to base of anal point. Laterosternite IX with 1–2, 1 setae. Phallapodeme 208–220, 215 µm long, transverse sternapodeme 68–80, 75 µm long. Gonocoxite 392–404, 396 µm long; superior volsella phylliform 68–76, 72 µm long; inferior volsella digiform 308–328, 322 µm long. Gonostylus 240–284, 254 µm long. HR 1.53–1.65, 1.59; HV 3.40–3.64, 3.51.

Female and immatures unknown.

Distribution and habitat: The species is only known from southern Brazil, where it was taken in light traps close to a large, shallow lake.



Figs 1–5. *Axarus froehlichi* sp. n.: 1 = cibarial pump, tentorium and stipes, 2 = thorax, 3 = wing, 4 = anal point, tergite IX and dorsal aspect of left gonocoxite and gonostylus, 5 = hypopygium with tergite IX and anal point removed, left: dorsal aspect, right: ventral aspect

Axarus rogersi BECK et BECK, 1958

Axarus rogersi BECK et BECK, 1958: 27.

Material examined: Costa Rica, Heredia Province, La Selva Biological Station, 10°26'N 83°59'W, 150 m a.s.l., 3. May 1993, 1 male, Malaise trap, O. A. SÆTHER (ZMBN). Mexico: Campeche State, Calakmul, Ejido Cristóbal Colón, Arroyo Colón, 34 km South of Xpujil, 18°12'59.4''N, 89°27'23.8''W, 420 m a.s.l., 7. May 1997, 9 males, light trap, A. CONTRERAS-RAMOS *et al.* (ZMBN).

Distribution and habitat: The species is known from USA, Costa Rica and Nicaragua (SPIES & REISS 1996). The present paper adds a record from southeastern Mexico and also a new record from Costa Rica. The specimens were all taken in wet, lowland tropical forests.

*

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TAXONOMIC STUDIES ON THE GENUS PSEUDOHADENA ALPHÉRAKY, 1889 (S. L.) PART VI. DESCRIPTIONS OF EIGHT NEW TAXA OF PSEUDOHADENA (S.L.) AND A NEW HETEROGRAPHA STAUDINGER, 1877 SPECIES (LEPIDOPTERA, NOCTUIDAE)*

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The supraspecific groups of the genus *Pseudohadena* s. l. are revised, their phylogenetic connections are discussed, a new genus, *Orohadena* gen. n. and two new subgenera (*Megahadena* within *Eremohadena* and *Bryohadena* within *Orohadena*) are established. Two new species of *Pseudohadena* (s. str.), *P. (P.) albilacustris* sp. n. (Mongolia) and *P. (P.) igorkostyuki* sp. n. (Russia: Transbaikalia) and a new species of *Jaxartia*, *Pseudohadena (Jaxartia) leucochlora* sp. n. (Turkmenistan) are described. The species of the *Eremohadena coluteae* species-group are revised, the descriptions of two new species, *E. raja* sp. n. (Pakistan) and *E. catalampra* sp. n. (Chinese Turkestan) and a new subspecies, *E. catalampra cyanochlora* ssp. n. (Transalai) are given. The identity of *E. coluteae* is clarified, *E. arvicola* is synonymized with *E. coluteae*. Two new *Orohadena* species, *O. (Orohadena) cardinalis* sp. n. (Afghanistan) and *O. (Bryohadena) nekrasovi* sp. n. (Tadjikistan), and a new *Heterographa* species, *H. thoenyi* sp. n. (Kazakhstan) are described. With 40 figures.

Key words: Noctuidae, *Eremohadena*, *Pseudohadena* s.l, *Heterographa*, new species, revised stati, new synonymies

INTRODUCTION

In the part V of our studies on the generic group *Pseudohadena*, the genus *Pseudohadena* ALPHÉRAKY, 1889 has been re-defined and re-described, and also two new genera: *Eremohadena* RONKAY, VARGA et FÁBIÁN, 1995 and *Graphantha* RONKAY, VARGA et FÁBIÁN, 1995 have been erected. Now, based on the study of important recent material and on the revision of some types, we describe several new taxa. Simultaneously, we attempt to evaluate some phylogenetically important supraspecific characters of *Pseudohadena* and related genera. Based on these

* Results of the Lepidopterological Research Project of the Himalayan Wildlife Foundation and the Hungarian Natural History Museum for the exploration of the fauna of the Deosai National Park and the Northern Areas of Pakistan, No. 3.

characters, we try to outline the major cladistic relationships within this generic group and to re-evaluate the taxonomical ranking of the supra-specific taxa.

The diagnostic genital characters considered are as follows:

– Male genitalia: Shape of valva, presence (or reduction) of cucullus and corona, presence and specialisations of digitus (including secondary dyssymmetrisation), size, shape and reversibility of harpe; shape of juxta including specialisation of the apical part of the juxta; shape of the vesica, orientation, shape and size of diverticula, specialisations of the surface of the vesica (scobination, hair-like structures), presence or reduction of terminal cornutus etc. The character stati in the genera, subgenera and species groups are considered on the Table 1.

– Female genitalia: Plesiomorphic features: The ribbon-like signa (four, rarily two); sclerotized antrum bursae, always wrinkled or rugose appendix bursae. Autapomorphic characters: spot-like signa (*Jaxartia*) or fully reduced signa (*Jaxartia*); the stepwise reduction of signa can be found in parallel lineages, e.g. in *Graphantha* or *Pseudohadena* s. str.; the complex, sclerotized plate of the antrum bursae of *Eremohadena*; the heavily sclerotized, crenulate crest of the ductus bursae of *Eremohadena*. The broad, often horizontally semilunar, densely setose ovipositor with wide, long, falcate 8th segment and the elongate, often retroflexed, large appendix bursae with partly sclerotized wrinkles, ribs or crests are recognized as synapomorphies of *Graphantha*, *Jaxartia*, partly *Pseudohadena* (and also of *Scotocampa* STAUDINGER, 1888).

The lock and key structures of the genitalia of the complementer parts of the female antrum and ductus bursae and the male vesica can be found in many, diverse forms in all major groups of the *Pseudohadena* generic group. The often similar appearance of these morphological structures cannot be considered as apomorphies.

In male genitalia the most important plesiomorphic characters are essentially the same, which also characterize the "Ground plan" of *Hadeninae* s.l. (incl. *Hadenini* s. str., *Orthosiini*, *Xylenini* and the bulk of the former "*Ipimorphinae*" sensu FIBIGER & HACKER 1990): developed cucullus and corona; presence of digitus (extension of the dorso-costal sclerotisation of valva); elongate, mobile harpe; not specialised clavus, united with dorsal margin of sacculus; broad, shield-shaped juxta; elongate, tubular vesica without specialised surface structures, but with terminal cornutus. The most typical "ensemble" of these characters can be observed in "*Pseudohadena*" *xanthophanes* and related species, described here as *Orohadena* gen. n.: *Orohadena xanthophanes* (BOURSIN, 1944), *O. cardinalis* sp. n., *O. presbytis* (HAMPSON, 1910), *O. clementissima* (RONKAY et VARGA, 1993), *O. no-*

bilis (GYULAI et RONKAY, 1997) and in a somewhat modified form, with reduced cornuti: *O.* (*Bryohadena* subg. n.) *nekrasovi* sp. n.

Some of these derived characters may appear as reductions of typical structures, convergently evolved in different genera and subgenera. Such convergent characters are:

- The reduction of cucullus and corona, e.g. in *Pseudohadena* (*P.*) *arenacea* RONKAY, VARGA et FÁBIÁN, 1995 and some *Eremohadena* species (see: *E. siri*-group, *E. catalampra* sp. n.),
- The reduction of the terminal cornutus in *Pseudohadena* s.str., *Pseudopseustis, Graphantha* and *Eremohadena.*

Noteworthy, the supposed sister-groups of the taxa mentioned above, usually preserved the plesiomorphic terminal cornutus: *Pseudopseustis* and *Jaxartia* (the sister-groups of *Pseudohadena*; species groups *Pseudohadena (Jaxartia) elinguis, P. (J.) evanida* and *P. (J.) jordana*), the *G. commoda* species-group within the genus of *Graphantha* (the former "subgenus" *Dysgraphhadena*, sister-group of the species-groups *P. laciniosa* and *P. gnorima*) and *Orohadena* (sister-group of *Eremohadena*).

The true monophyletic units within the generic groups are characterised by some peculiar apomorphic characters. In the genus *Pseudohadena*, such characters are the broad, flattened harpe and the fine, needle-like digitus. The genus *Graphantha* is characterised by the very specialised, "fur-like" superficial structures of the vesica and by the "reversible" harpe, which can be derived as the slightly modified form of the flattened harpe of *Pseudohadena*. The monophyly of *Pseudohadena* and *Graphantha* has been demonstrated by the specialised (synapomorphic), apically elongate ("tongue-shaped") and strongly sclerotized form of juxta (see: RONKAY & VARGA 1989, RONKAY *et al.* 1995). The other phyletic line consists of the relic-like, plesiomorphic *Orohadena* species, being mostly endemic to the Central Asiatic high mountains, and the genus *Eremohadena*, much more rich in species, more dispersed into the eremic zonobiomes and subdivided into several species groups. This latter genus is characterised by some autapomorphic characters, e.g. the dyssymmetrisation of the distal part of valva in the species-pair *E. rjabovi* (BOURSIN, 1970) – *E. megaptera* (BOURSIN, 1970), or the very sophisticated lock-and-key structures in the species-group *E. roseotinctoides* (POOLE, 1989) – *E. siri* (ERSHOV, 1874) – *E. adscripta* (PÜNGELER, 1914) – *E. pugnax* (ALPHÉRAKY, 1892) or in *E. catalampra* sp. n.

The cladogram (Fig. 40), based on the character stati described above, demonstrates that the generic group "*Pseudohadena*" (s. l.) has been subdivided into two main phyletic lines, both consisting of two main sister groups, considered here as genera. The taxonomic consequence of that is the description of *Orohadena* as

new genus and also the withdraw of the subgenus *Dysgraphhadena* RONKAY, VARGA et FÁBIÁN 1995, despite of the fact that it represents a monophyletic species group.

If they would be here regarded as subgenera, the nomenclatural consequence of this splitting would be the erection of 8 genera and 15 subgenera. Thus, we accepted a practical solution, having considered here only the four basic lines as genera (one of them is described here as new) and the 8 major divergent lines (+ *Jaxartia*) within them as subgenera (three of them are described here as new).

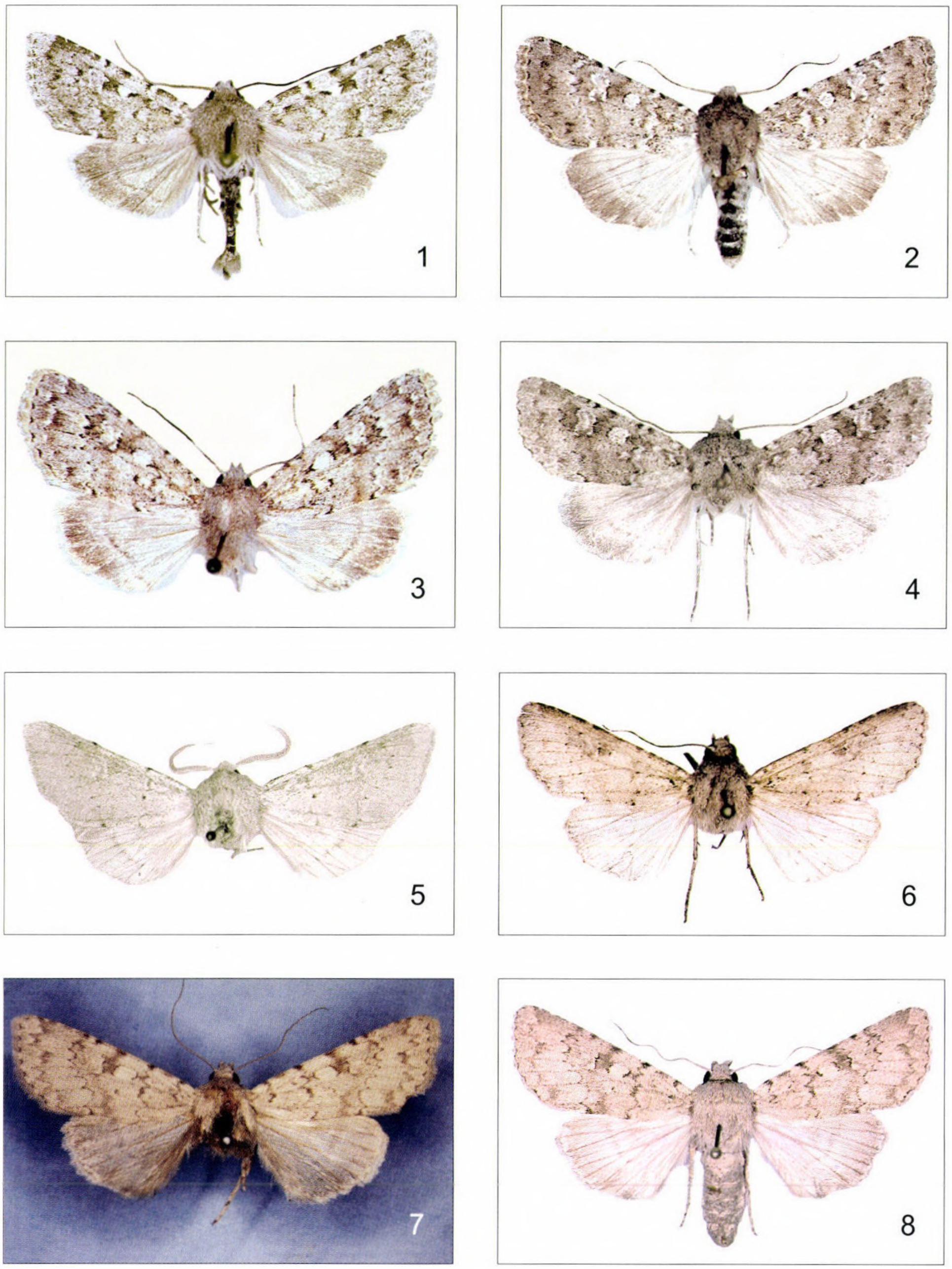
Abbreviations: HNHM – Hungarian Natural History Museum, Budapest; ZMHU – Museum für Naturkunde der Humboldt-Universität, Berlin; ZSM – Zoologisches Staatssammlung, München; CPGY – coll. PÉTER GYULAI, Miskolc; CGR – coll. GÁBOR RONKAY, Budapest

SYSTEMATIC PART

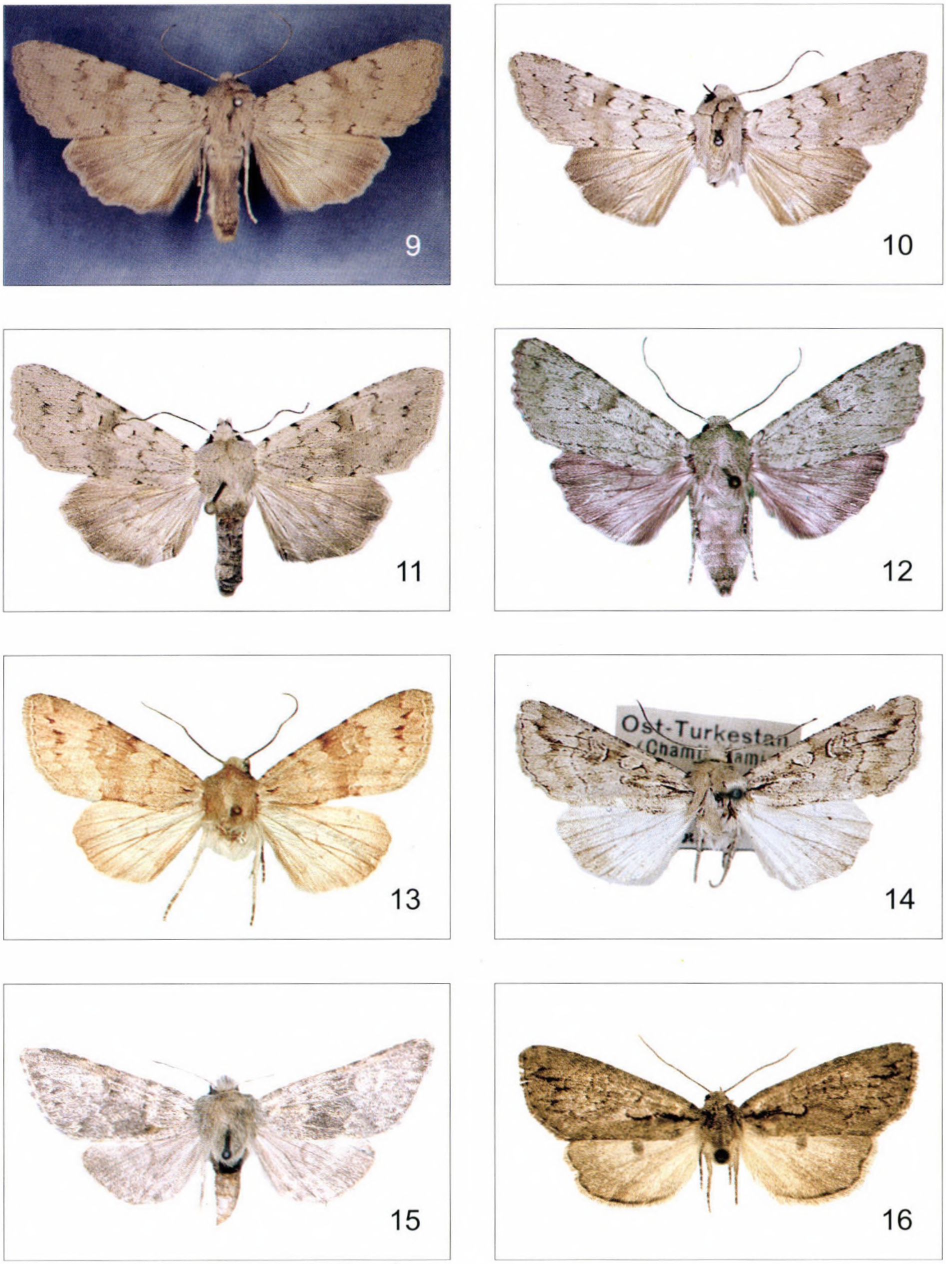
Checklist of the species of the *Pseudohadena* generic complex (mentioned formerly as *Pseudohadena*)

Genus *Pseudohadena* ALPHÉRAKY, 1889
- type species: *armata* ALPHÉRAKY, 1887 (*Hadena*)
  - Subgenus *Pseudohadena* ALPHÉRAKY, 1889
    - type species: *armata* ALPHÉRAKY, 1887 (*Hadena*)
      - *arenacea*-group
        - *arenacea* RONKAY, VARGA et FÁBIÁN, 1995 (Fig. 1)
      - *armata*-group
        - *armata* (ALPHÉRAKY, 1887) (Fig. 2)
        - *igorkostyuki* **sp. n.** (Fig. 4)
        - *phasmidia* RONKAY, VARGA et FÁBIÁN, 1995
        - *argyllostigma* (VARGA et RONKAY, 1991)
        - *albilacustris* **sp. n.** (Fig. 3)
        - *obsoleta* RONKAY, VARGA et FÁBIÁN, 1995
  - Subgenus *Pseudopseustis* HAMPSON, 1910
    - type species: *tellieri* LUCAS, 1907 (*Taeniocampa*)
      - *tellieri*-group
        - *tellieri* (LUCAS, 1907)
  - Subgenus *Jaxartia* PÜNGELER, 1914
    - type species: *elinguis* (PÜNGELER, 1914) (*Jaxartia*)
      - *elinguis*-group
        - *striolata* (FILIPJEV, 1949)

elinguis (PÜNGELER, 1914)
evanida-group
evanida evanida PÜNGELER, 1914
evanida psammoxantha RONKAY, VARGA et FÁBIÁN, 1995
leucochlora **sp. n.** (Fig. 5)
pseudamoena (BOURSIN, 1943)
deserticola RONKAY, VARGA et FÁBIÁN, 1995
cymatodes (BOURSIN, 1954)
jordana-group
jordana (STAUDINGER, 1900)
Genus *Graphantha* RONKAY, VARGA et FÁBIÁN, 1995
type species: *laciniosa* CHRISTOPH, 1887 (*Chloantha*)
Subgenus *Graphantha* RONKAY, VARGA et FÁBIÁN, 1995
(*Dysgraphhadena* RONKAY, VARGA et FÁBIÁN, 1995, **syn. n.**)
type species: *laciniosa* CHRISTOPH, 1887 (*Chloantha*)
laciniosa-group
laciniosa laciniosa (CHRISTOPH, 1887)
laciniosa hethitica (RONKAY et VARGA, 1989)
laciniosa odontographa (RONKAY et VARGA, 1989)
calligrapha (RONKAY et VARGA, 1989)
gnorima-group
gnorima gnorima (PÜNGELER, 1906)
gnorima hololampra (RONKAY et VARGA, 1989)
gnorima peregovitsi (RONKAY et VARGA, 1989)
commoda-group
sergia (PÜNGELER, 1901)
commoda (STAUDINGER, 1889)
idumaea (PÜNGELER, 1901)
schlumbergeri (PÜNGELER, 1905)
stenoptera (BOURSIN, 1970)
Subgenus *Gryphadena* KUSNEZOV, 1908, **stat. rev.**
type species: *minuta* PÜNGELER, 1900 (1899) (*Pseudohadena*)
minuta-group
indigna (CHRISTOPH, 1887) **comb. n.**
minuta minuta (PÜNGELER, 1900 (1899)) **comb. n.**
minuta pseudocommoda (BOURSIN, 1963) **comb. n.**
minuta sengana (BRANDT, 1941) **comb. n.**



Figs 1–8. 1 = *Pseudohadena arenacea*, male, paratype; 2 = *P. armata*, female, Kazakhstan; 3 = *P. albilacustris* sp. n., female, paratype; 4 = *P. igorkostyuki* sp. n., male, holotype; 5 = *P. (Jaxartia) leucochlora* sp. n., male, holotype; 6 = *Eremohadena (Eremohadena) raja*, sp. n., male, holotype; 7 = *E. (E.) coluteae*, male, holotype; 8 = *E. (E.) coluteae korshunovi*, female, paratype



Figs 9–16. 9 = *Eremohadena (Eremohadena) catalampra* sp. n., male, holotype; 10 = *E. (E.) catalampra* sp. n., male, paratype; 11 = *E. (E.) catalampra*, sp.n., female, paratype; 12 = *E. (E.) catalampra cyanochlora* ssp. n., male, paratype; 13 = *Orohadena (Orohadena) cardinalis* sp. n., female, holotype; 14 = *O. (O.) presbytis*, male; 15 = *Orohadena (Bryohadena) nekrasovi* sp. n., male, paratype; 16 = *Heterographa thoenyi* sp. n., male, holotype

Genus *Eremohadena* RONKAY, VARGA et FÁBIÁN, 1995
type species: *siri* ERSHOV, 1874 (*Mamestra*)
Subgenus *Eremohadena* RONKAY, VARGA et FÁBIÁN, 1995
type species: *siri* ERSHOV, 1874 (*Mamestra*)
coluteae-group
coluteae coluteae (BIENERT, 1869) (Fig. 7).
arvicola (CHRISTOPH, 1887) **syn. n.**
coluteae banghaasi (BYTINSKY-SALZ et BRANDT, 1937) **stat. rev.**
coluteae rhodostola (BOURSIN, 1962) **comb. n.**
coluteae korshunovi (RONKAY et VARGA, 1993) **comb. n.** (Fig. 8)
raja **sp. n.** (Fig. 6)
siri-group
siri (ERSHOV, 1874)
roseotinctoides (POOLE, 1989)
orias (RONKAY & VARGA, 1993)
roseonitens (OBERTHÜR, 1887)
adscripta (PÜNGELER, 1914)
pugnax (ALPHÉRAKY, 1892)
oxybela (BOURSIN, 1963)
chenopodiphaga-group
chenopodiphaga chenopodiphaga (RAMBUR, 1832) **comb. n.**
chenopodiphaga erubescens (STAUDINGER, 1901) **comb. n.**
chenopodiphaga roseotincta (TURATI, 1929) **comb. n.**
halimi (MILLIÉRE, 1877) **comb. n.**
immunda (EVERSMANN, 1842) **comb. n.**
pexa (STAUDINGER, 1889) **comb. n.**
catalampra-group
catalampra catalampra **sp. n.** (Figs 9–11)
catalampra cyanochlora **ssp. n.** (Fig. 12)
Subgenus *Megahadena* **subgen. n.**
type species: *megaptera* BOURSIN, 1970 (*Pseudohadena*)
immunis-group
immunis immunis (STAUDINGER, 1889) **comb. n.**
immunis lesghica (BOURSIN, 1943) **comb. n.**
megaptera-group
rjabovi (BOURSIN, 1970) **comb. n.**
megaptera (BOURSIN, 1970) **comb. n.**

Genus *Orohadena* **gen. n.**
type species: *xanthophanes* BOURSIN, 1944 (*Pseudohadena*)
Subgenus *Orohadena* **subgen. n.**
type species: *xanthophanes* BOURSIN, 1944 (*Pseudohadena*)
xanthophanes-group
xanthophanes xanthophanes (BOURSIN, 1944) **comb. n.**
xanthophanes rhodocyanea (BOURSIN, 1963) **comb. n.**
cardinalis **sp. n.** (Fig. 13)
presbytis-group
presbytis (HAMPSON, 1910) **comb. n.** (Fig. 14)
clementissima (RONKAY et VARGA, 1993) **comb. n.**
nobilis (GYULAI et RONKAY, 1997) **comb. n.**
Subgenus *Bryohadena* **subgen. n.**
type species: *nekrasovi* **sp. n.**
nekrasovi-group
nekrasovi **sp. n.** (Fig. 15)

Pseudohadena albilacustris sp. n.
(Figs 3, 17, 32)

Holotype: male, "Mongolia, Bayankhongor aimak, Mankhan, Böön-Tsagaan-nuur, 31 km W of Baa-tsagan sum, 02–03.09.1997, leg. P. Gyulai and A. Garai", slide No. RL6151 (coll. P. GYULAI, deposited in HNHM Bp.).

Paratype: female, with the same data as the holotype (coll. G. RONKAY). Slide No. RL6152 (female).

Diagnosis: The closest relative of the new species is *Pseudohadena argyllostigma* (VARGA et RONKAY, 1991), the main distinctive features are as follows: the forewing ground colour of *P. albilacustris* is paler, more whitish, the dark markings are more diffuse, less extensive in both sexes.

The male genitalia of the two sibling taxa are very close, the new species has broader, more curved harpe and more scobinate distal half of the vesica than those of *P. argyllostigma* (VARGA et RONKAY, 1991), the subterminal diverticulum of the vesica projecting more to ductus ejaculatorius in *P. albilacustris* while it is projected towards the basal bulb in *P. argyllostigma*.

The female genitalia of *P. albilacustris* are similar to *P. argyllostigma* but the gonapophyses are shorter, the ostium bursae is more quadratic with less rounded anterior angles, the ductus bursae is broader, membranous, without sclerotized ribs at the posterior end but with stronger anterior scobination and with small sclerot-

ized crest at its junction to appendix bursae. The appendix bursae is rounded conical, ribbed and finely sclerotized in *P. albilacustris*, the corpus bursae is considerably shorter, less elongate, more elliptical and the signum-stripes are significantly longer, stronger, continuous while the appendix of *P. argyllostigma* is more conical, membranous, the corpus bursae is long, narrowly saccate and the signum-stripes are shorter, weaker, partly interrupted.

The differences between the *P. albilacustris* – *P. argyllostigma* pair of species and *P. igorkostyuki* are discussed in the diagnosis of the last taxon.

Description: Wingspan 30.5–32 mm, length of forewing 15.5–17.5 mm. Male. Head, palpi, thorax and pubescence of legs ochreous white mixed with grey and brownish hair-scales. Antenna pale brown, finely serrate, with tiny setae and long, dense cilia. Ground colour of forewing ochreous white, irrorated with brownish scales. Orbicular and reniform stigmata rather large, filled with clear white and a few pale brown scales, other parts of cell somewhat darker, olive-brown. Orbicular stigma rounded, reniform almost quadrangular, encircled partly with brown scales; claviform obsolescent. Ante- and postmedial crosslines rather diffuse, sinuous, partly double, greyish brown, with stronger costal patches; median fascia obsolescent. Subterminal more or less continuous, diffuse, white, defined by indistinct greyish brown patches on both sides; terminal line blackish, weak, interrupted, cilia ochreous, marked with two pale brown stripes. Hindwing whitish, marginal area with stronger, basal part with scarce brown suffusion, transverse line diffuse, arcuate; cilia whitish. Underside of wings whitish, irrorated with brown scales, inner area of forewing suffused with greyish brown. Traces of orbicular and reniform stigmata, transverse lines of both wings and discal spot of

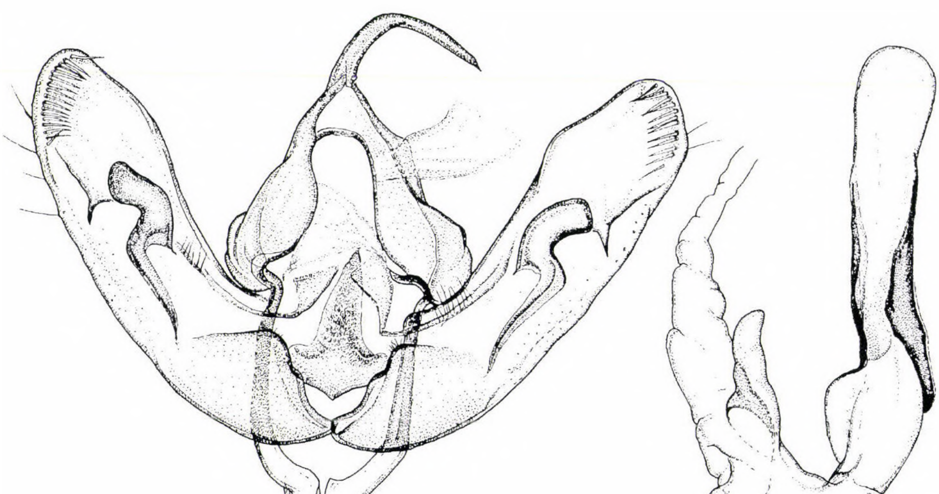


Fig. 17. *Pseudohadena albilacustris*, sp. n., holotype, genital capsula and aedeagus with vesica everted

hindwing well-discernible. Female. As male, but paler, body and forewing more whitish, hindwing somewhat darker; antenna filiform.

Male genitalia (Fig. 17): uncus relatively long, slender, tegumen high, penicular lobes rather narrow. Fultura inferior sclerotized, subdeltoidal, with more or less triangular basal plate and long, cuneate apical extension. Valva elongate, distally slightly dilated, apex rounded, corona weak, short. Costal plate strong, broad, its ventral extension short, fine, acute. Sacculus short, clavus reduced to small, setose protuberance, harpe flattened, sclerotized, medially curved, apically rounded. Aedeagus cylindrical, carina with two inequal sclerotized ventro-lateral plates, left plate much longer, cuneiform. Vesica broadly tubular, everted forward, recurved dorso-laterally. Basal part inflated, finely ribbed, medial and distal parts narrower, scobinate. Medial curve with two small, rounded diverticula at outer side, terminal part with long, narrowly conical diverticulum at inner side, projecting towards ductus ejaculatorius.

Female genitalia (Fig. 32): ovipositor short, papillae anales slightly falcate, densely hairy, with a row of long, fine subbasal and a few shorter but stronger apical setae; gonapophyses rather short, strong. Ostium bursae broad but short, more or less quadrangular, ventral lamina smaller but stronger, dorsal plate larger, scobinate. Ductus bursae short, slightly twisted, membranous with fine wrinkles. Posterior part dilated, anterior end scobinate, with small sclerotized crest at junction to appendix bursae. Appendix bursae small, rounded conical, finely sclerotized and wrinkled, corpus bursae elliptical-sacculiform, membranous with fine wrinkles and with four strong, equally long, ribbon-like signa.

Bionomics and distribution: The type locality of the new species is the shore of the Böön-Tsagaan-nuur (lake). The lake is surrounded with a narrow field of salty flats (because of the salt water of the lake) and with a wide belt of differently built sandy dunes. Some of the dunes are yet moving, but most of them are covered with old *Haloxylon* vegetation. The collecting in this locality resulted in, with the exception of this new species and of *Luperina zollikoferi* FREYER, 1836, only a small amount of specimens belonging to widespread, common species.

Pseudohadena igorkostyuki sp. n.
(Figs 4, 18)

Holotype: male, "Russia, Transbaicalia, Chita region, Borzja, 27–30.VIII.1998, leg. Golovushkin", slide No. RL6664 (coll. G. RONKAY, in HNHM Budapest).

Diagnosis: The new species belongs to the *P. armata* species-group, differing externally from *P. armata* (ALPHÉRAKY, 1887) and *P. phasmidia* RONKAY, VARGA et FÁBIÁN, 1995 by its generally darker, more greyish forewing ground colour, stronger, more sharply defined stigmata and darker hindwings. The male genitalia of *P. igorkostyuki* are similar to those of *P. armata* (Fig. 19) and *P. phasmidia* but the cucullus is shorter, broader, more quadrangular, apically less pointed, the harpe is longer, narrower, the apical process of the fultura inferior is

longer, the uncus is somewhat shorter and the ventro-medial diverticulum is larger than in the related two species.

P. igorkostyuki differs from *P. albilacustris* and *P. argyllostigma* by its darker forewing colouration and pattern, shorter, less broadened, more quadrangular apical part of valva, longer, narrower harpe, the presence of the medial diverticula of the vesica (they are absent in the other two species), larger pocket-like and shorter subconical distal diverticula.

Description: wingspan 39 mm, length of forewing 18 mm. Male. Head, palpi, thorax and pubescence of legs dark slate grey mixed with a few blackish and whitish hair-scales. Axis of antenna dark grey, with long fasciculate cilia. Forewing rather broad triangular with apex finely pointed, outer margin slightly crenulate. Ground colour dark slate-grey, irrorated with darker grey-brown and whitish scales. Ante- and postmedial crosslines, sinuous, partly double, greyish brown, defined with blackish-brown and whitish scales, costal patches also blackish; median fascia diffuse, sinuous, dark grey. Orbicular and reniform stigmata large, orbicular rounded, reniform elliptical, both encircled partly with blackish grey scales, filled with whitish, reniform also with fine grey inner annulus. Spaces between orbicular and reniform stigmata and between reniform stigma and postmedial line dark grey, darkest parts of wing; claviform small, rounded, encircled with dark grey-brown, filled with whitish grey. Subterminal line more or less continuous, diffuse, white, defined by indistinct greyish shadow at inner side. Terminal line blackish, interrupted, with stronger spots between veins.

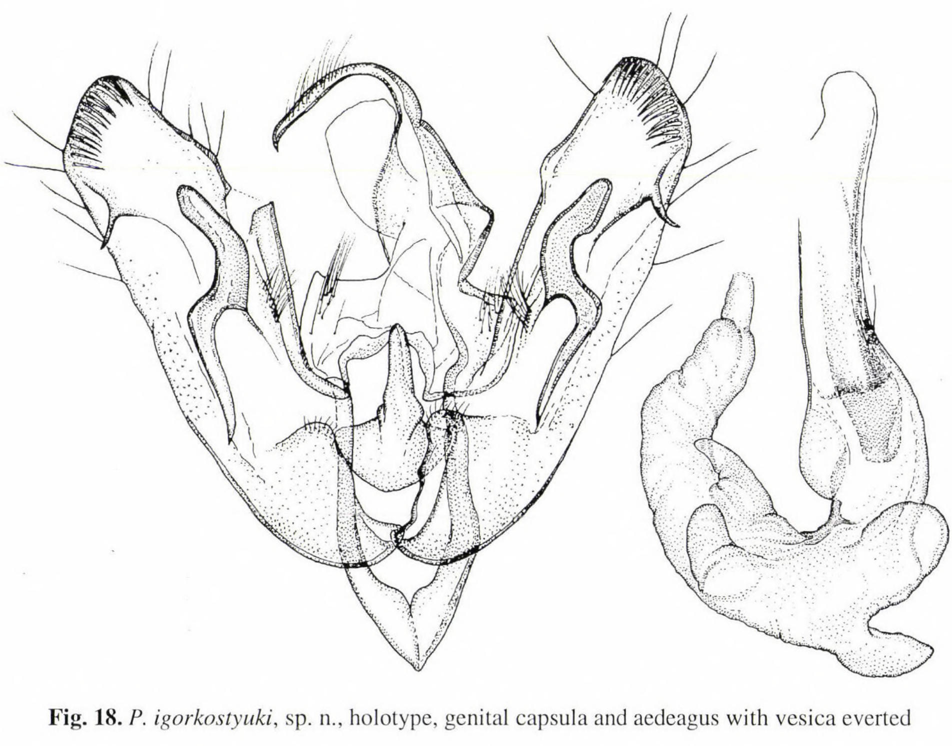


Fig. 18. *P. igorkostyuki*, sp. n., holotype, genital capsula and aedeagus with vesica everted

Hindwing suffused with brownish grey, veins, diffuse transverse line and marginal area even darker, discal spot absent; cilia whitish with darker grey medial line. Underside of wings whitish, inner area of forewing suffused with greyish brown, other parts and hindwing irrorated with grey-brown scales. Traces of orbicular and reniform stigmata (latter with whitish centre) and transverse line of forewing, discal spot and transverse line of hindwings darker grey. Female unknown.

Male genitalia (Fig. 18): uncus medium-long, slender, tegumen narrow, high, penicular lobes more or less quadrangular, with pointed tips. Fultura inferior sclerotized, subdeltoidal, apical extension long, straight. Valval elongate, distally only slightly dilated forming weak, rounded costal lobe, cucullus short, rather quadrangular than triangular, with apex rounded, corona weak. Costal plate broad, strong, ventral extension short, slender, pointed. Sacculus short, clavus small, rounded, setose, harpe sclerotized, long, slender, medially curved, apical third lanceolate with pointed tip. Aedeagus cylindrical, carina with two inequal, sclerotized ventro-lateral plates, left plate larger, broader. Vesica broadly tubular, everted forward, recurved dorsally. Basal part inflated, finely ribbed, inner curve with longer crests. Medial and distal parts narrower, covered with minute, hair-like spiculi. Medial third with two diverticula, one of them semiglobular, projected ventrally, other one rather long, tubular, projected forward. Distal third also with two diverticula, a subconical, rather long one at inner side, projecting towards ductus ejaculatorius, and a somewhat shorter, pocket-like one at outer side.

Bionomics and distribution: The unique specimen of the species was collected at light in Transbaikalia, representing the easternmost known locality of the entire *Pseudohadena* (s. str.).

Pseudohadena (Jaxartia) leucochlora sp. n.
(Figs 5, 20)

Holotype: male, "Turkmenistan, Kopetdag mtr., Garrygala env., 1–15.11.1995, leg. Miatleuski J.", slide No. RL7262 (coll. J. STUMPF, Lauda, Germany).

Paratype: male, from the same site (coll. A. BECHER).

Diagnosis: The closest relatives of the new species are *Pseudohadena (Jaxartia) evanida* and *P. (J.) pseudamoena*, these three species represent a separate line within the *P. (J.) evanida* species-group. These sibling species are externally rather similar, *P. (J.) leucochlora* differs from its close relatived by its almost completely reduced forewing pattern and the characteristic pale greenish-whitish slate-grey colouration of the body and the forewings.

The ground plan of the male genitalia of *Jaxartia* is rather uniform, the synapomorphies of the *P. (J.) evanida* species-group are the enlarged valvae with large, often flattened, distally broadened harpe and the broadly tubular, inflated vesica with two large distal diverticula and with well-developed, stick-like terminal cornutus. The configuration of the male genitalia of *P. (J.) leucochlora* is very similar to that of *P. (J.) pseudamoena* but the fultura inferior of the new species is

more deltoidal, medially much less constricted and the dorsal process is significantly shorter; the harpe is more elongate, longer and narrower, distally less dilated, apically less pointed, the cornutus of the vesica is shorter, thicker and the dorsal half of the tegumen is more rounded, not angular. The differential characters of the new species, as compared with those of *P. (J.) evanida*, are the shorter but much broader, flattened, distally dilated harpe, the more triangular, more pointed cucullus with the corona located more marginally, the medially more constricted fultura inferior, the dorsally more rounded tegumen and the more tubular vesica with shorter diverticula (especially of terminal one), thicker cornutus and the absence of the sclerotized basal plate at ventral edge of the carina.

Description: Wingspan 46 mm, length of forewing 21 mm. Male. Head rather small, eyes large, globular, palpi short, obliquely porrect; tongue reduced to very short, wedge-shaped proboscis consisting of convergent, thick setae. Antenna widely bipectinate, with rows of long cilia on each segment. Thorax broad, collar and tegulae less distinct, metathoracic tuft large. Forelegs with 4+1 huge, curved claw-like digging spines; abdomen slender, long. Pubescence of head, tips of palpi, thorax and legs pale, whitish slate-grey with fine greenish hue, mixed with sparse brown hairs. Dorsal surface of antennae also whitish; sides of palpi dark grey-brown, abdomen whitish grey. Forewing elongate, rather broad, with acutely triangular apical part; outer margin finely laced, upper half rather straight. Ground colour of forewing as that of body, rather dull, with very weak darker greyish brown

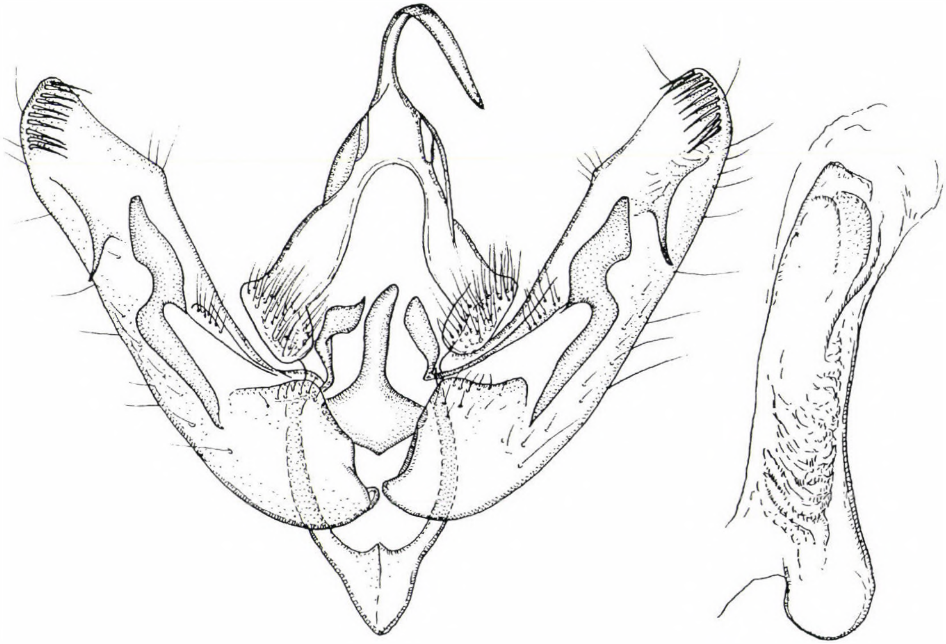


Fig. 19. *P. armata*, holotype, genital capsula and aedeagus

irroration. Wing pattern obsolete, reduced to traces of simple, interrupted, sinuous greyish brown antemedial and postmedial crosslines (appearing mostly as darker spots on veins), a dark dot at place of claviform stigma (darkest mark of wing) and to pale shadow of reniform stigma, being somewhat lighter than ground colour, with fine plumbeous grey inner lunule. Cilia slightly paler, ochreous-whitish, with very fine brownish medial line. Hindwing shining, very pale brownish grey, with diffuse but clearly recognizable transverse line; cilia ochreous white, with obsolete brownish line. Underside of wings whitish slate-grey, irrorated sparsely with brownish grey; inner area of forewing more greyish. Forewing discal spot a weak, fine greyish streak, transverse line present but diffuse on both wings, stronger on forewing. Female unknown.

Male genitalia (Fig. 20): Uncus relatively long, broad at base, distally tapering, distal half flattened, apex rounded. Tegumen medium-long, broad, penicular lobes rather narrow, rounded. Fultura inferior sclerotized, subdeltoidal, with more or less rhomboidal basal plate and relatively short, triangular dorsal (apical) extension; vinculum short, strong, U-shaped. Valva large, elongate, medial third slightly dilated, apical third rather strongly tapering into triangular, apically finely pointed cucullus; corona rather weak, short. Costal plate strong, broad, its ventral extension acutely but broadly triangular, extending only slightly over ventral margin. Sacculus short, rounded, clavus reduced; editum well-developed, flattened, rounded triangular. Harpe large, flattened, heavily sclerotized, basally curved, distally considerably dilated, arched, apically finely rounded. Aedeagus long, thick, cylindrical, carina with strong ventral and ventro-lateral plates. Vesica broadly tubular, everted forward, recurved ventro-laterally. Walls of vesica membranous, densely scobinate and verrucose, distal end finely ribbed. Posterior half of vesica with two large diverticula, distal end with long, straight, distally slightly dilated, apically finely pointed terminal cornutus.

Bionomics and distribution: The type locality of the new species is the vicinity of Kara-Kala, being incorrectly spelled in the locality labels as "Garrygala". A

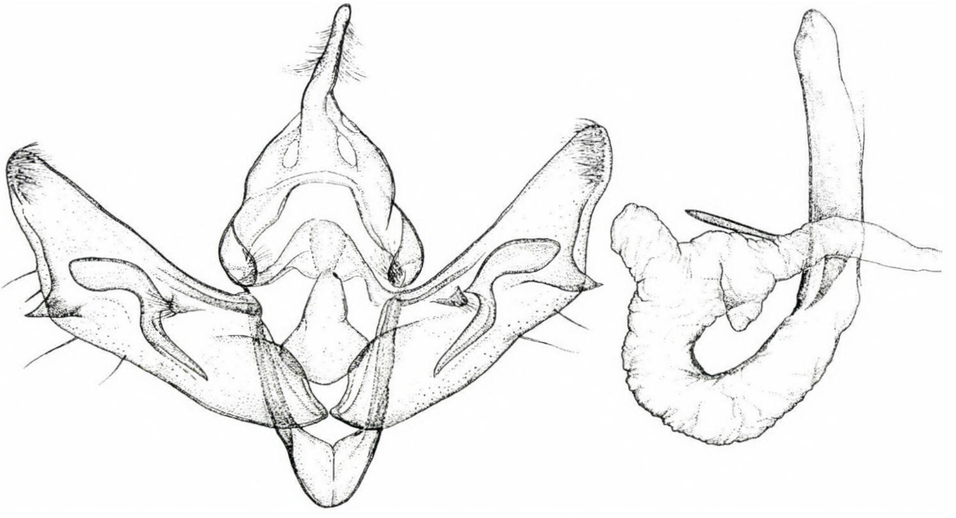


Fig. 20. *Pseudohadena (Jaxartia) leucochlora*, sp. n., holotype, genital capsula and aedeagus

late autumnal species, the flight period is November, supposedly also December. The early stages and the habitats are unknown, the specimens were collected at light.

TAXONOMIC NEWS IN THE GENUS EREMOHADENA RONKAY, VARGA ET FÁBIÁN, 1995

The genus *Eremohadena* was erected for the *siri*-group of the former *Pseudohadena* s. l., the members of the genus are listed in the original description. The taxonomic position of the *"P." coluteae* and the *"P." arvicola* species-groups has, however, changed during the subsequent studies. The checking of the holotype of *E. coluteae* (BIENERT, 1869), preserved in the STAUDINGER collection (ZMHU Berlin) revealed the surprising fact that the types of *E. coluteae* and *E. arvicola* (CHRISTOPH, 1887) represent the same species, therefore *E. arvicola* is a junior subjective synonym of *E. coluteae* (**syn. n.**). In the light of this statement the curious type locality of "*E. coluteae*" sensu auctorum (Iran: Shahkuh) became easily understandable: it is not the far westernmost locality of a Central Asian species confined to the central and eastern regions of the Tien Shan massif but just oppositely, the core area of a western Asian species occurring in northern Iran and in Turkmenistan with an isolated eastern subspecies, *E. coluteae korshunovi* (RONKAY et VARGA, 1993) (**comb. n.**) known from the Kugitang-Tau Mts.

In addition, as a result of the recent faunistic investigations in the Pakistani Himalayas, another species of the species-group was discovered. According to the configuration of the male genitalia, this species (*E. raja* **sp. n.**) shows a peculiar mixture of plesiomorphic and apomorphic characters, partly those features which are common with *Pseudohadena* or *Eremohadena*, partly being autapomorphic for this "missing" link between the taxa of the genera *Pseudohadena* and *Eremohadena*. The male genital structure of *E. raja* displays the way of speciation from a hypothetic common ancestor of the two genera, being much closer to that of the *E. coluteae* group.

The species formerly known as *E. coluteae* is yet undescribed, although there is a manuscript name for the taxon. A short series of specimens from Chinese Turkestan (Aksu, Djarkent) are labelled as *P. catalampra* PÜNGELER, with the designation of the holotype ("Type"), but the description of the taxon had not been published. Moreover, the species is rather homogeneous within its known area except in its westernmost range (Transalai) where an externally conspicuously different population was discovered. The two taxa are easily distinguishable by the

colouration and the wing pattern of the forewing but the male genitalia of them are almost identical.

The species and species-groups of the genus are listed in the checklist, the descriptions of the new subgenus, *Megahadena* **subgen. n.** for the *megaptera*- and *immunis*-groups, and the new species and subspecies are given below.

Eremohadena (Eremohadena) raja sp. n.
(Figs 6, 21)

Holotype: male, "PAKISTAN, Kashmir, Himalaya Mts, 30 km N Murree, near Nathia Gali, Ayubia village, 2600 m, 22–25.X.1998, leg. Gy. M. László & G. Ronkay", slide No. RL6597 (coll. G. RONKAY, in HNHM, Budapest).

Paratypes. Pakistan: 1 male, Kashmir, Himalaya Mts, 30 km N Murree, near Dungha Gali, Ayubia, 25–2600 m, 3.IV.1999, leg. BENEDEK & SZABÓ (coll. BENEDEK); 1 male, with the same data, coll. †M. HREBLAY (Érd). Slide No. RL6705 (male).

Diagnosis: The new species differs externally from its closest relative, *E. (E.) coluteae korshunovi*, by its smaller size, narrower, paler, more shiny forewings with less distinct crosslines and stigmata and more whitish hindwings, the armature of the basal segment of the foretarsus is also different.

The male genitalia of the two sister species, *E. (E.) raja* and *E. (E.) coluteae* are rather similar but the configuration of the two copulatory organs differ in almost all details. The most conspicuous differences can be found in the shape and size of the cucullus, the costal extension, the harpe and the structure and armature of the vesica which are as follows: The cucullus of *E. (E.) raja* is much shorter, smaller, than that of *E. (E.) coluteae*, it is more or less quadrangular with triangular subapical lobe, the corona is much shorter. The costal extensions of the new species are asymmetrical, short, triangular, pointed on left valva, fully reduced on right valva, the harpe is considerably shorter, not S-shaped but curved at basal quarter, then straight towards apex. The vesica of *E. (E.) raja* is smaller, shorter, less inflated, more complex, with smaller medial diverticula but with short, spiniform terminal cornutus which is absent in *E. (E.) coluteae*. In addition, the clavi of the new species are significantly larger, apically more rounded, the basal part of the uncus is dilated and the valva is generally narrower than those of the sister species.

Description: Wingspan 40 mm, length of forewing 18 mm. Male. Pubescence of head and thorax unicolorous, pale ochreous slate-grey, mixed with a few brownish hair-scales. Head broad, eyes large, rounded, frons smooth, with large cap-like, prominent tuft, palpi short, slender, upturned, third segment very short, male antenna shortly ciliate, with small basal tuft. Collar homogeneous, rather narrow, tegulae slender, less prominent, pro- and metathoracic tufts reduced. Abdomen cylindrical,

smoothly scaled, shining, pale ochreous grey, dorsal crest absent, abdominal coremata present but short, weak. Fore tibiae with large, flat claw, basal segment of foretarsus with four long, strong, slightly curved spines ventro-laterally, two additional large spines at apex of segment and with two complete rows of rather long spines ventrally. Mid- and hind tibiae smooth, basal segments of tarsi with three complete rows of spines. Forewing elongate, with apex finely rounded, outer margin evenly arcuate. Ground colour pale, very shiny ochreous slate-grey, irrorated with a few dark brown scales. Wing pattern indistinct, ante and postmedial crosslines obsolescent, sinuous, represented mostly by dark spots on veins. Basal dash spot-like, median fascia and subterminal line pale, diffuse, shadow-like. Orbicular and reniform stigmata large, less distinct, former rounded, latter elliptical, both marked by their whitish grey filling, outlines represented by a few whitish and dark brown scales. Space between orbicular and reniform stigmata darker grey, darkest marking of forewing; claviform absent. Terminal line fine, continuous, dark grey, cilia whitish with darker medial line. Hindwing shining, slightly transparent whitish, irrorated with pale brownish grey, veins finely covered with pale brown. Discal spot absent, crossline obsolete but visible as a row of darker spots on veins. Marginal area with a few brownish scales, cilia white. Underside of wings shining, almost patternless, whitish, inner area of forewing with slight brownish irroration, trace of reniform somewhat darker, lunulate. Female unknown.

Male genitalia (Fig. 21): Uncus short, lanceolate, with deltoidal basal half and almost straight distal process; apex finely rounded. Tegumen medium-high, narrow, penicular lobes large, rounded quadrangular, densely hairy. Fultura inferior sclerotized, large, more or less quadrangular, lateral margins straight, parallel, with small triangular lobes at middle; apical part somewhat narrower, finely granulose, apex with fine incision. Vinculum sclerotized, strong, long, V-shaped. Valva elongate, apically slightly tapering, costa with small, triangular subapical lobe. Cucullus small, more or less triangular with finely pointed apex, corona weak, very short. Sclerotized parts of cuculli slightly asymmetrical: left cucullus having small, pointed ventral extension. Sacculus sclerotized, clavus huge, bear-ear-shaped, sparsely setose. Harpe strong, rather thick, curved at basal third, distal two-third straight, with apex rounded. Editum sclerotized, rounded triangular, hairy. Aedeagus medium-long, tubular, arcuate, carina with shorter, sclerotized ventral plate and with two longer lateral bars extending towards into proximal part of vesica. Basal two-third of vesica broadly tubular, scobinate, with smaller conical and larger semiglobular diverticula on ventral side. Distal third membranous, bent ventro-laterally, with pointed, wedge-shaped, rather short spine dorsally. Abdominal coremata present.

Bionomics and distribution. The holotype specimen was found at a rather high part of the Murree Hills where Himalayan coniferous and mixed forests and shrubby rocky slopes can be found, in some steep parts rocky grassland patches also occur. The specimen came to the light in late October, together with the characteristic taxa of the west Himalayan winter fauna (e.g. the species of the genera *Nyctycia* HAMPSON, 1906, *Hyalobole* WARREN, 1911, *Apostema* WARREN, 1913, *Owadaglaea* HACKER et RONKAY, 1997, etc.) and it was in rather good condition. The two paratypes were found a year later in the same area, at the early springtime, both specimens were freshly emerged with huge fat bodies. Now, we cannot decide, whether the new species has a rather long aestivation period, or it has two generations in a year.

Etymology: The new species is dedicated to our friend, Mr RAJA ALI ANWAR KHAN (Gilgit, Pakistan), owner of the Golden Peak Tours, organizator of numerous lepidopterological expeditions to the Northern Territories of Pakistan.

Eremohadena (Eremohadena) catalampra sp. n.
(Figs 9–11, 22–24, 33)

coluteae BIENERT, 1870 sensu auctorum, *catalampra* PÜNGELER, manuscript name

Holotype: male, "Ost-Turkestan (Aksu)/Rueckbeil 1910", "Type catalampra Pueng. /R. PUENGELER" (coll. PÜNGELER, in ZMHU Berlin).

Paratypes: China. 1 male, 1 female, with the same data as the holotype (coll. PÜNGELER, ZMHU Berlin), 1 male, Mustagata, Yarkend (HNHM), 1 female, Chinese Turkestan, Aksu (HNHM); 1 male, 1 female, "Tienschan (Dscharkent)/Rueckbeil 1903" (ZMHU Berlin). Kazakhstan. 1 male, Semirechensk, Djarkend (HNHM). Kirghisia. A large series from the Tien Shan Mts, Sary-Djaz, 3300 m, 10–18.VII.1998, leg. VODYANOV, 1 female, Tien Shan Mts, Tash-Koro, 2700 m, 20.VII. 1984, leg. KOROVIN (HNHM, P. GYULAI, G. RONKAY); 1 male, "Dscharkent, Coluteae Bien."; 1

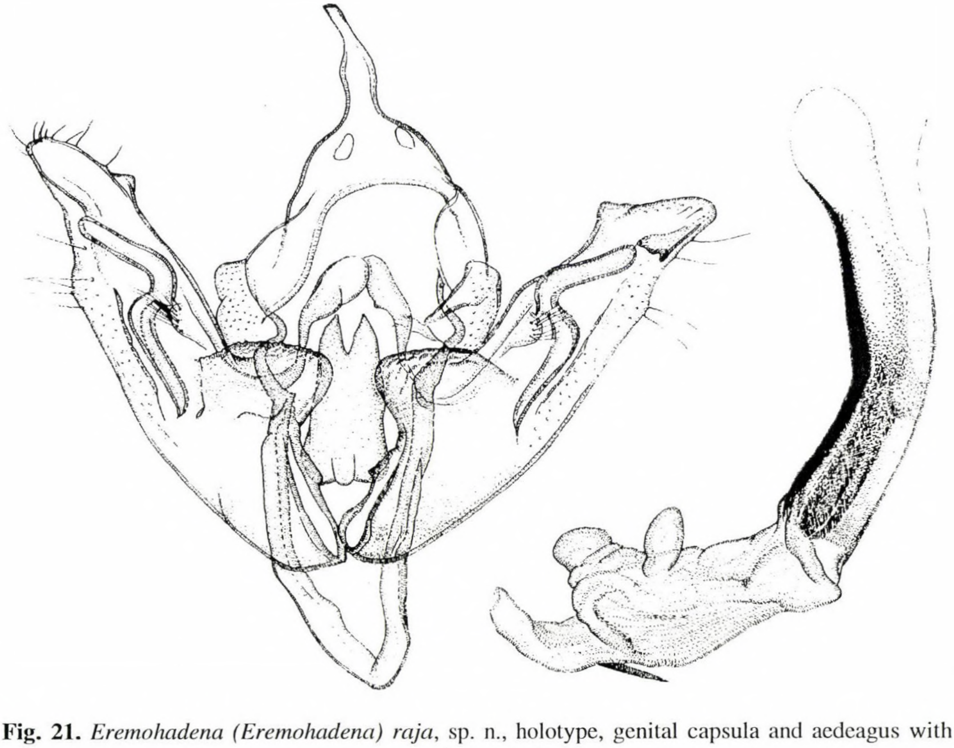


Fig. 21. *Eremohadena (Eremohadena) raja*, sp. n., holotype, genital capsula and aedeagus with vesica everted

male, "Pseudohadena coluteae" (no locality given); 1 female, "Aksu, ex coll. Tancré", "Coluteae Bien., det. L. Osthelder; coll. Osthelder"; 1 male, 2 females, Aksu, ex coll. Tancré (ZSM).

Slide Nos GYP963, RL3841, VZ5679 (males), GYP994, GYP996, RL5199 (females).

Diagnosis. The new species differs externally from all congeners by its pale ashy grey or ochreous slate-grey forewings with fine, often rather indistinctly marked crosslines and stigmata, and the bright, unicolorous milky whitish underside of both wings, irrorated with only a few darker scales. The male genitalia of *E. (E.) catalampra* are similar in type to those of the related *E. (E.) coluteae* but the uncus is shorter and weaker; the penicular lobes are not pointed apically but more auriculate; the cucullus is reduced, the costal process ("digitus") is not flattened, not wide-based but narrow, arcuate with pointed apex; the harpe is shorter, reversed S-shaped and pointed; the aedeagus has a lip-shaped appendage ventrodistally; and the vesica has relatively smaller diverticula and not helicoidally recurved. The female genitalia are also similar to those of *E. (E.) coluteae* but the anterior gonapophyses are shorter and stronger and the antrum has smaller, narrower ventral plate with fine, rounded caudal lobe medially, and with larger but weaker, quadrangular dorsal plate. The ductus bursae is membranous, less rugulose, without patches of granulose sclerotisation, but the inner surface is covered densely with minute spiculi. In addition, the appendix bursae of the new species is relatively smaller, subconical than that of *E. (E.) coluteae.*

The new species has two, externally easily separable subspecies, *E. (E.) c. catalampra* and *E. (E.) c. cyanochlora* ssp. n., the male genitalia of whose show only slight differences.

Description: wingspan 44–47 mm, length of forewing 21–23 mm. Sexes similar. Pubescence of head and thorax unicolorous, pale ochreous slate-grey, mixed with a few brownish hair-scales. Head broad, eyes large, rounded, frons smooth, with large cap-like, prominent tuft, palpi short, slender, upturned, third segment very short, male antenna shortly ciliate, with small basal tuft. Collar homogeneous, rather narrow, tegulae slender, less prominent, pro- and metathoracic tufts reduced. Abdomen cylindrical, smoothly scaled, shining, pale ochreous grey, dorsal crest absent, abdominal coremata present but short, weak. Fore tibiae with large, flat claw, basal segment of foretarsus with four-five long, strong, more or less straight spines ventro-laterally, without additional spines at apex of segment. Forewing elongate with apex pointed, cilia slightly crenulate. Ground colour pale, shining ashy grey, ochreous grey or slate-grey, often with fine ashy grey covering and scarce brownish irroration. Wing pattern rather indistinct, ante and postmedial crosslines sinuous, simple, brownish, median fascia broad, diffuse, paler brown. Subterminal shadow-like, marked by a few dark chevron-like spots. Orbicular and reniform stigmata large, both encircled incompletely with brown, their filling ochreous- or whitish grey, paler than ground colour; claviform absent. Terminal line very fine, dark brown, cilia ochreous-whitish, with pale brown medial line. Hindwing pale ochreous, suffused with brown, veins covered with brownish. Discal spot obsolete, transverse line diffuse but visible. Marginal area broadly covered with darker brown, cilia whitish. Underside of wings milky whitish, inner area of forewing irrorated with pale grey-brown, hindwing with a few brownish scales. Discal spots minute, dark, transverse lines absent or obsolete. Female. As male, antenna filiform.

Male genitalia (Figs 22–24): Uncus relatively short, wedge-shaped, tegumen low, broad, penicular lobes well-developed, triangular, apically finely pointed. Fultura inferior large, sclerotized, broadly deltoidal, apically pointed; vinculum short, strong, V-shaped. Valva elongated, costal margin widely sclerotized, almost straight, cucullus small, with apex finely rounded, covered with short hairs at apex and along ventral edge of sclerotized costa; corona missing. Sacculus short, clavus represented by rounded, setose surface. Harpe strong, more or less thorn-like, curved at medial third, apical part flattened, with apex finely rounded. Costal extension situated close to apex, strong, acute, extending slightly over ventral margin. Aedeagus straight, cylindrical, rather thick, ventral part of carina forming stronger plate curved ventrally. Vesica tubular, everted forward, curved ventro-laterally at medial third, inner curve partly covered with fine, hair-like spiculi. Basal half broadened, with strong dorsal wrinkles and with tiny ventral diverticulum at edge of carina. Distal part with two rather long, subconical dorsal diverticula, terminal part tapering, membranous.

Female genitalia (Fig. 33): Ovipositor medium-long, papillae anales weak, small, trapezoidal, densely hairy, gonapophyses long, slender; 8th segment broad, sclerotized, anterior gonapophyses rather short, strong. Ostium bursae calyculate, membranous, ventral surface with small, narrow sclerotized plate with fine, rounded caudal lobe medially, dorsal surface with somewhat larger but much weaker, quadrangular plate. Ductus bursae relatively long, distal half tubular, proximal part considerably broader, both parts membranous, inner surfaces covered densely with minute spiculi. Proximal part with a few stronger ribs, and with long, broad, heavily sclerotized, falcate ventro-medial crest. Appendix bursae small, subconical, rugose, corpus bursae elliptical, membranous, entire surface finely wrinkled, with four long, ribbon-like signa.

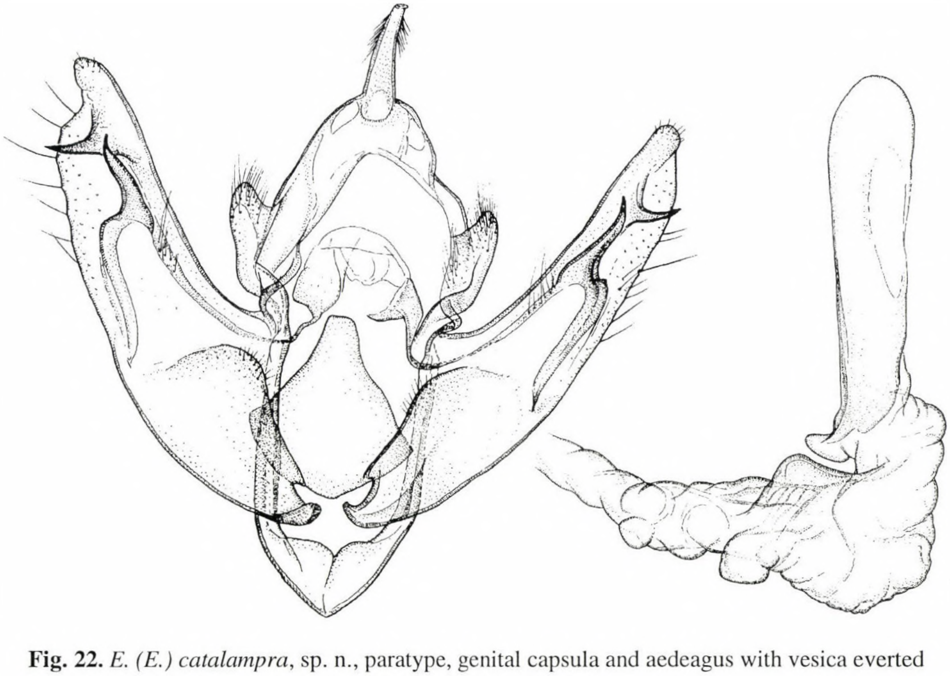


Fig. 22. *E. (E.) catalampra*, sp. n., paratype, genital capsula and aedeagus with vesica everted

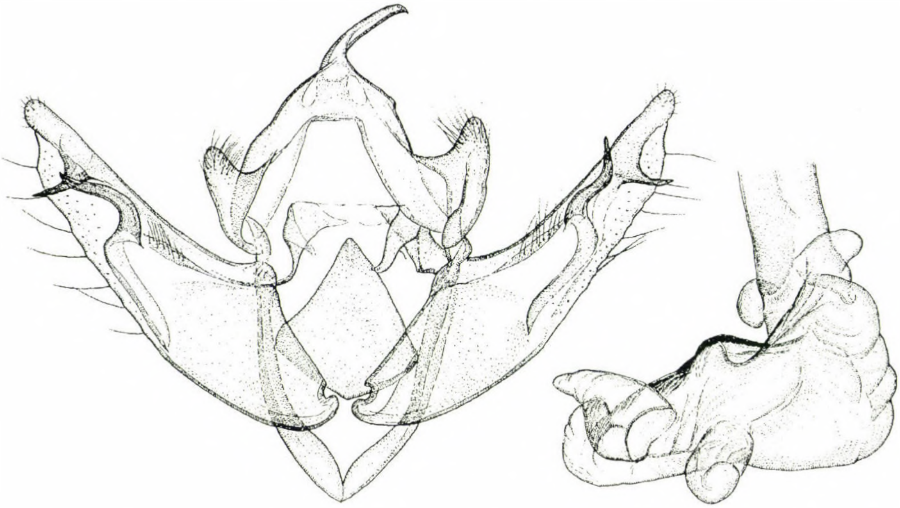


Fig. 23. *E. (E.) catalampra*, sp. n., paratype, genital capsula and aedeagus with vesica everted

Bionomics and distribution. The new species is rather widespread in the central and eastern parts of the Tien Shan massif, being characteristic to the higher zones. In spite of its rather wide range of distribution, it appears as local and only a

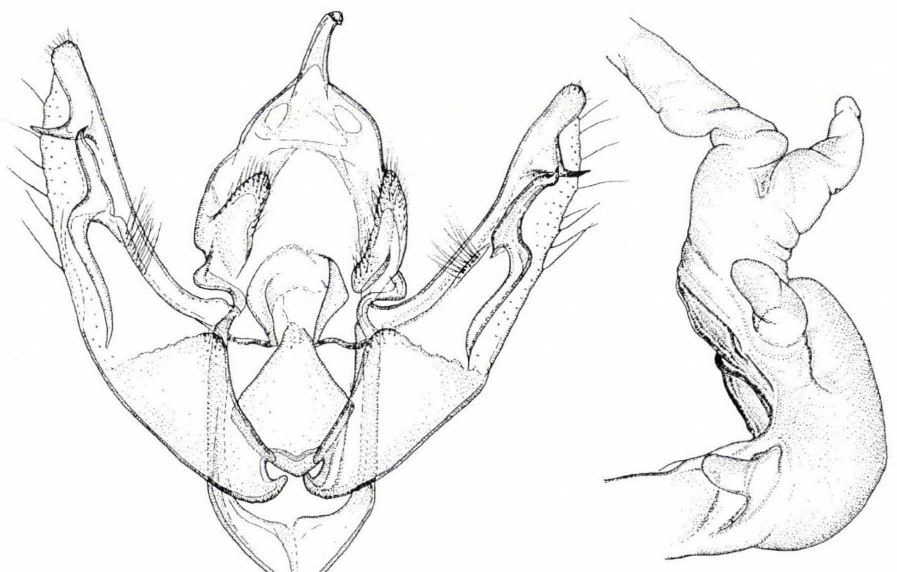


Fig. 24. *E. (E.) catalampra*, sp. n., paratype, genital capsula and aedeagus with vesica everted

few examples are known from most of its localities. It was found as more frequent in certain areas of Chinese Turkestan and in Kirghisia (Tash-Koro, Sary-Djaz).

Remarks. As mentioned above, this species has been considered by authors as "*Pseudohadena coluteae*" until now. We decided to preserve the manuscript name of PÜNGELER and its designated "Type" as holotype for the species which has long been misinterpreted, except PÜNGELER who recognized the distinctness of this taxon from *E. (E.) coluteae*, although the description of the species has never been published.

Etymology. The specific name refers to the shiny forewings of the species.

Eremohadena (Eremohadena) catalampra cyanochlora ssp. n.
(Figs 12, 25)

Holotype: male, "Kirghisia, Transalai, Aram Kungei, 3000–3200 m, 20–21.VII.1995, leg. Lukhtanov", slide No. 877 GYULAI (coll. P. GYULAI, deposited in the HNHM, Budapest).

Paratype: 1 male, with the same data as the holotype (coll. G. RONKAY). Slide No. RL6646 (male).

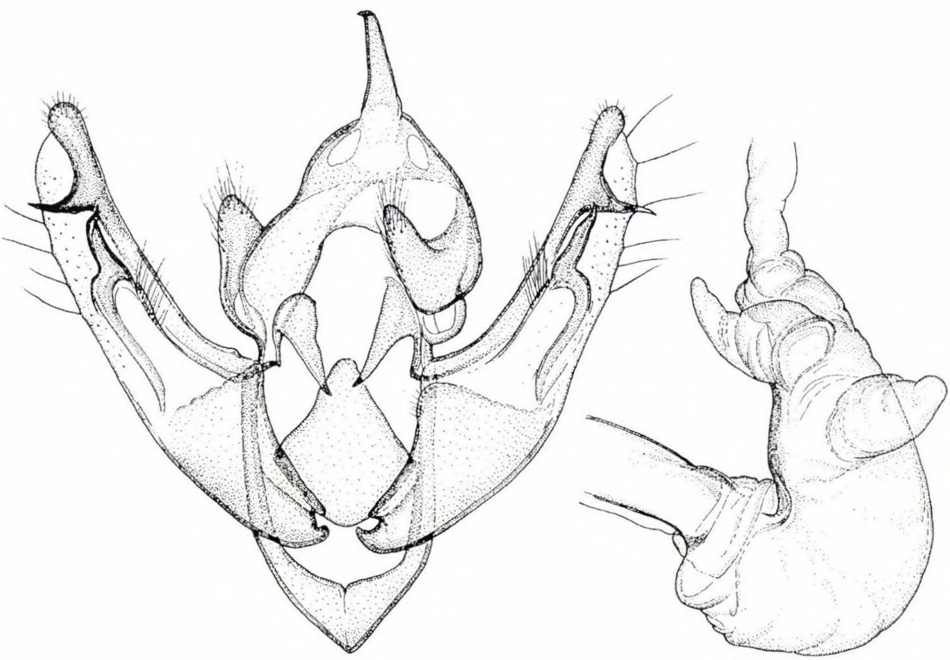


Fig. 25. *E. (E.) catalampra cyanochlora*, ssp. n., holotype, genital capsula and aedeagus with vesica everted

Diagnosis: The new subspecies resembles externally to the nominotypical *E. (E.) c. catalampra* but its forewing is narrower, more elongate, the ground colour is darker, with characteristic bluish-greenish slate-grey suffusion, the wing pattern is more indistinct, the hindwing and the undersides of both wings are also darker. Wingspan 21–22 mm, length of forewing 45–46 mm. The male genitalia of *E. (E.) catalampra cyanochlora* (Fig. 25) differ slightly from those of *E. (E.) c. catalampra* by its somewhat longer harpe and costal extension, broader basal part of fultura inferior and by the smaller basal diverticulum of the vesica.

Bionomics and distribution. The bionomics of the westernmost known population of *E. (E.) catalampra* is poorly known, the two specimens were collected in the midsummer period, at a high altitude range in the western part of the Tien Shan massif.

Etymology. The subspecific name refers to the greenish forewing colouration.

Eremohadena (Eremohadena) orias (RONKAY et VARGA, 1993) (Fig. 26)

The species was described on the basis of the unique female holotype specimen. As a result of the new lepidopterological expeditions to Iran, further females

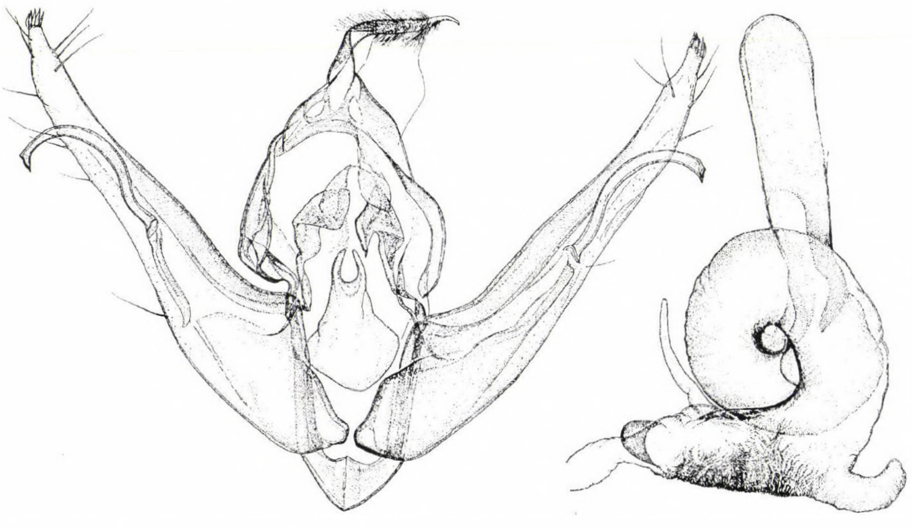


Fig. 26. *Eremohadena (E.) orias*, genital capsula and aedeagus with vesica everted

and a sole male specimen were collected in the Iranian side of the Kopet-Dagh Mts (Khorassan) and in the deserts expanding southwards from the mountains of Khorassan. The description of the male genitalia and the comparison of the male genital features of *E. (E.) orias* with the closely related two species are given below.

Diagnosis. The male genitalia show the general characters of the *siri*-species group of the genus *Eremohadena* RONKAY, VARGA et FÁBIÁN, 1995. It has been confirmed that *E. orias* (RONKAY et VARGA, 1993) is the closest relative of *E. (E.) siri* (ERSHOV, 1874) and *E. (E.) roseotinctoides* (POOLE, 1989). The most important specific characters of *E. (E.) orias*, comparing with those of the closest relatives mentioned above, are as follows: Uncus less lanceolate, more pointed terminally; tegumen higher and proportionally narrower; valva more strongly tapering towards apex, cucullus and costal extension ("digitus") fully reduced; medial diverticulum of vesica narrower and longer than in *E. (E.) siri*, larger than in *E. (E.) roseotinctoides*; subterminal "vermiform" diverticulum like as in *E. siri* and much longer than in *E. roseotinctoides*; terminal diverticulum much more expressed than in its related species, terminal cornutus fully reduced.

Description. Male genitalia (Fig. 26): Uncus elongate, slightly lanceolate and sinuous, apically pointed and finely hooked; tegumen high, triangular, penicular lobes reduced. Fultura inferior large, pentagonal, with arcuate, more or less pincer-shaped dorso-lateral ("apical") processi. Valva elongate, narrow, evenly tapering towards apex; cucullus reduced, with digitiform corona consisting of 6–7 thick setae. Sacculi symmetrical, not specialized; clavus reduced. Costal extension ("digitus") completely reduced; harpe elongate, relatively thin, falcate, with small, nipple-like protuberance terminally, basal bar of harpe almost straight, slender. Aedeagus long, straight; carina moderately sclerotised with elongate, bill-shaped dorsal plate and with longer ventral ribbon bent ventrad. Vesica huge, long, broadly tubular, membranous, surface of medial and subterminal parts covered densely with minute spiculi. Basal part projected ventrally, recurved helicoidally with hook-shaped medial, vermiform subterminal and broad, flattened terminal diverticula; terminal cornutus completely reduced.

Megahadena subgen. n.

Type species: *megaptera* (BOURSIN, 1970) (*Pseudohadena*)

Diagnosis. Most important diagnostic characters of the new subgenus are the reductive and dyssymmetrisation tendencies of the male genitalia and also some distinctive characters of the female genitalia. The genitalia of the both sexes show several typical characters of the genus *Eremohadena*, described in RONKAY *et al.* (1995). However, they can be easily distinguished from the species of the subgenus *Eremohadena* s. str. by the following characteristics: In the male genitalia the very slender, S-shaped harpe and the long, nearly straight aedeagus with membranous vesica, with the reduction of cornuti and scobinate surfaces; in the female

genitalia the long, nearly straight ductus bursae with sclerotized, calyciform antrum and without pouch-shaped proximo-lateral appendages, and the relatively small, sclerotized appendix bursae, respectively.

The subgenus is subdivided into two species groups (see above), represented by three species, *E. (M.) immunis*, *E. (M.) rjabovi* and *E. (M.) megaptera*, respectively.

Description. Large (*E. (M.) immunis*) or very large (*E. (M.) rjabovi, E. (M.) megaptera*) moths. Antenna filiform, in male very shortly ciliate. Thorax and abdomen strong, abdomen long, without dorsal crests of scales. Ground colour usually dull brown, greyish-brown or ochreous ("beige"), in fresh specimens with silky shine. Collar and tegulae usually concolorous. Forewing triangular, elongate apically. Markings regular, often obsolescent. Ante- and postmedial lines double, crenulate. Maculation regular.

Male genitalia (see BOURSIN 1970, and Figs 27, 28): Huge, heavily sclerotized. Uncus thin, of moderate length, tegumen broad triangular, peniculi lobes small, rounded or quadrangular, juxta very large, broad, in *E. (M.) immunis* elongate dorsally ("tongue-shaped"). Valva elongate, with nearly parallel margins (*E. (M.) rjabovi* and *E. (M.) megaptera*) or with a hump-like convex sclerotisation of dorsal costa (*E. (M.) immunis*). Cucullus and corona fully reduced (*E. (M.) immunis*) or cucullus small, quadrangular with one row (*E. (M.) megaptera*) or with several rows (*E. (M.) rjabovi*) of strong setae. Digitus reduced (*E. (M.) immunis*) or strong, acute, dyssymmetrical. Harpe very long and thin, S- or questionmark-shaped, spatulate terminally (*E. (M.) immunis*) or dyssymmetrical, slender on right side, strong and tapering towards apex on the left side (*E. (M.) rjabovi* and *E. (M.) megaptera*). Aedeagus long, slightly curved distally or nearly straight. Vesica membranous with medial and subterminal diverticula. Terminal cornutus reduced or small, thin (*E. (M.) immunis*).

Female genitalia (Figs 34, 35): Papillae anales relatively small, weakly sclerotized, quadrangular, covered with thin setae. Antrum calyciform, sclerotized, with two sclerotized longitudinal lamellae. Ductus nearly straight, without proximo-lateral appendages, sclerotized, with two more strongly sclerotized longitudinal lamellae bilaterally. Bursa large, elliptical, with four strong, stripe-like signa. Appendix bursae relatively small, semiglobular or slightly conical, sclerotized.

The female genitalia of the species of the subgenus are illustrated here for the first time.

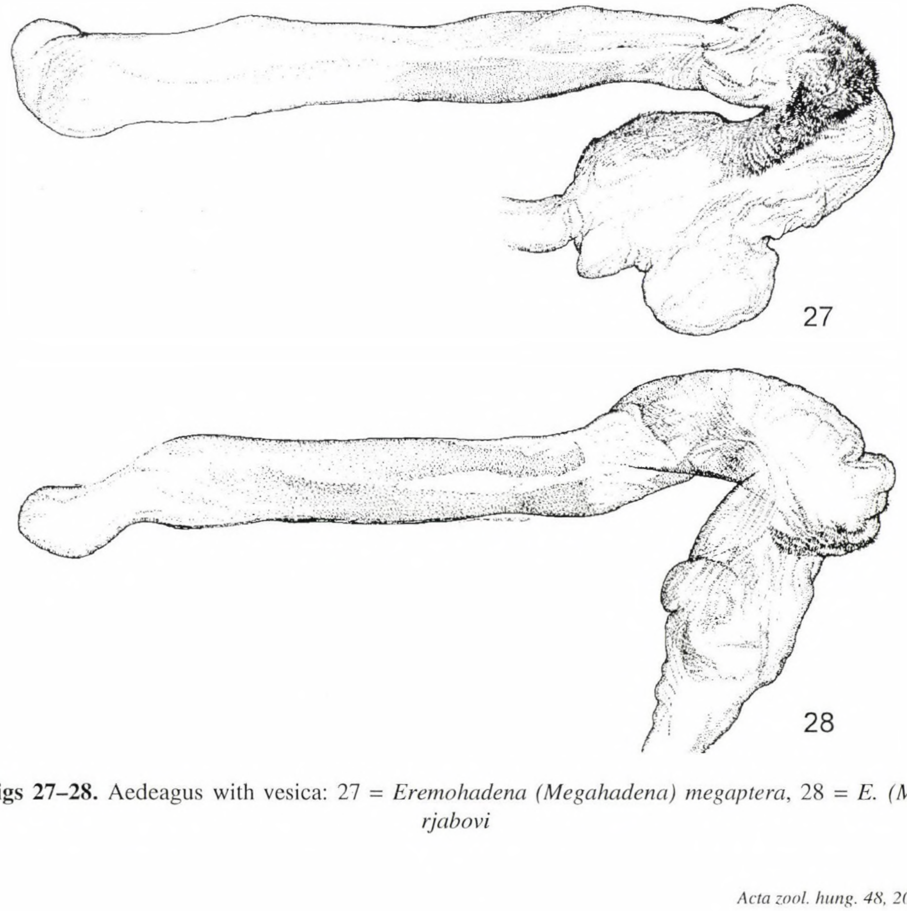
Orohadena gen. n.

Diagnosis. The members of the new genus are quite diverse according to their external characters. Most taxa of the *O. xanthophanes* species group excluding the type species of the genus (*O. cardinalis* sp. n., *O. presbytis* (HAMPSON, 1910), *O. clementissima* (RONKAY et VARGA, 1993), *O. nobilis* (GYULAI et RONKAY, 1997)) resemble mostly the larger members of the *Graphantha commoda* species-group, having arrowhead-shaped apical pattern of the forewing, while *O. xanthophanes* is quite similar to some *Eremohadena* species. On the other hand, *O. (Bryohadena) nekrasovi* sp. n. has a rather curious look, being hardly separable externally from some *Bryopolia* or *Polymixis* species. The best diagnostic characters are to be found in the male genitalia: the parallelogramma-shaped, elongate valva

with very broad cucullus and corona; the rather strong, acute digitus; the falcate but apically not acute harpe; the complete lack of any dyssymmetrisation; the practically entirely plesiomorphic ground plan of the genitalia etc. The absence of numerous autapomorphies being typical of the genus *Eremohadena*, fully justifies the generic rank of *Orohadena*.

Description. Large (nearly all!) or medium-sized (*O. (O.) presbytis*) moths with large, triangular forewing, full and regular pattern, often with dark, arrowhead-shaped pattern apically and with greyish-ochreous, sometimes pinkish, often shiny (metallic) colouration.

Male genitalia with many plesiomorphic characters: valva quadrangular, elongate with nearly parallel dorsal and ventral margins; cucullus and corona well-developed; corona with one row of numerous spines; digitus straight, strongly sclerotized, broad-based and acute apically; harpe elongate, falcate, rounded apically; clavus small, united with the dorsal margin of the sacculus; juxta broad, shield-shaped, without long apical process; vesica elongate, often very long (*O. (O.) xanthophanes*), tubular, without specialised surface structures, but – with the exception of *O. (B.) nekrasovi* – with strong, acute terminal cornutus.



Figs 27–28. Aedeagus with vesica: 27 = *Eremohadena (Megahadena) megaptera*, 28 = *E. (M.) rjabovi*

Female genitalia: papillae anales broad, short, more or less quadrangular, apically rounded, weakly sclerotized; antrum with sclerotised plates; bursa with subconical or cylindrical, rugose appendix and with large, elliptical, longitudinally finely wrinkled corpus, bearing 4 ribbon-like, longitudinal signa.

Orohadena (Orohadena) cardinalis sp. n.
(Figs 13, 36)

Holotype: male, "Afghanistan, Hindu Kush, Qari Deh, 2900 m, 23.VII.1973, leg. J. Wojtusiak", slide No. RL6804 (coll. Zoological Museum, University of Cracovia).

Diagnosis. The new species resembles mostly *O. (O.) xanthophanes* but paler in colouration, with fine pastel shade and all markings finer, less prominent than in its twin species. The antemedial and postmedial crosslines of *O. (O.) cardinalis* are less sinuous than in *O. (O.) xanthophanes*, the orbicular and reniform stigmata are smaller, encircled with fine ochreous-whitish lines, without darker definition, the hindwing is paler with finer marginal suffusion, etc.

The female genitalia of the new species are also similar in type to those of *O. (O.) xanthophanes* (Fig. 37), the distinctive features are as follows: the sclerotized part of the appendix bursae near the junction of ductus bursae is a flattened, more or less rounded, cristate-ribbed lamina in *O. (O.) cardinalis*, that of *O. (O.) xanthophanes* is much larger, forming a huge, croissant-shaped, heavily sclerotized, folded plate, extending much deeply into lateral, more helicoidal part of appendix bursae; the posterior part of the appendix bursae of *O. (O.) cardinalis* is largely sclerotized while it is membranous, finely gelatinous in *O. (O.) xanthophanes*. In addition, the signa of *O. (O.) cardinalis* are strongly inequal, those of *O. (O.) xanthophanes* are longer, equal in length.

Description. Wingspan 38 mm, length of forewing 19 mm. Female. Pubescence of head and thorax unicolorous, pale ochreous grey, mixed with a few brownish hair-scales, sides of palpi dark grey; antenna filiform. Vestiture of thorax rather homogeneous, collar and tegulae less distinct, pro- and metathoracic tufts present, relatively small. Forewing elongate with apex pointed, cilia slightly crenulate. Ground colour pale slate-grey, with intense ochreous shining and with scarce greyish-brownish irroration. Wing pattern also pale, basal dash very short, blackish brown, antemedial and postmedial crosslines rather obsolescent, simple, brownish, sinuous. Median fascia broad, diffuse, shadow-like, outer half of median field suffused with ochreous brown, darkest part of wing. Orbicular and reniform stigmata present but rather indistinct, both encircled with ochreous-whitish, former oblique, flattened, filled with ochreous, latter lunulate, filled with greyish, lower half darker grey; claviform absent. Subterminal indistinct, interrupted, whitish, strongly sinuous, marked with dark grey-brown chevrons. Terminal line very fine, brownish, consisting of distinct arches, followed by an ochreous line outwards. Cilia as ground colour, with pale brown medial line. Hindwing pale, brilliant ochreous, costal and marginal areas suffused with brown, veins covered with brownish. Discal spot

obsolete, transverse line also poorly visible; cilia long, whitish. Underside of wings milky whitish, most parts of forewing suffused with pale grey-brown, veins also darkened. Hindwing with a few brownish scales on veins and with a weak marginal suffusion, discal spot absent.

Female genitalia (Fig. 36): Ovipositor medium-long, papillae anales large, broad, densely hairy, posterior gonapophyses long, slender, anterior gonapophyses also rather long, fine. Ostium bursae relatively small, more or less pentagonal, sclerotized, ventral plate larger, dorsal plate smaller, quadrangular, with upturned, slightly folded lateral margins. Ductus bursae long, flattened, connected with ostium bursae by narrow, membranous neck. Distal half sclerotized, slightly angled at posterior third, proximal half membranous, with stronger ribs at junction to appendix bursae. Appendix bursae large, lateral half discoidal, its most parts sclerotized, medial half membranous with large, cristate-ribbed sclerotized area. Corpus bursae elliptical, membranous, finely wrinkled, with four inequal, variably long, ribbon-like signa.

Distribution. The species is known from the type locality only. The two sibling species are supposedly sympatric as the entire area of *O. (O.) xanthophanes*, extending from the Near East throughout the Middle East and the Central Asian xerothermic mountains to the north-western parts of the Himalayas, covers the Afghani Hindukush, too.

Bryohadena subgen. n.

Description, as follows, is essentially the abstract of the description of the single species: Large, robust moths with typical "raw" hairs and scales and with characteristic "dusky", dark greyish-greenish colouration and rather diffuse wing pattern. Forewing elongate, narrow triangular with apex acute.

Male genitalia characterised by the short, distally slightly dilated uncus; the very long, medially dilated valva, the very long, acute, strongly sclerotized digitus and by the relatively short and rounded cucullus with weakly expressed corona. Aedeagus long, cylindrical, carina with sclerotized plate ventrally. Vesica tubular, membranous, distal part finely scobinate, with a very short, pointed cornutus, terminal part with short spines.

Female genitalia: ovipositor rather short, papillae anales weakly sclerotized. Antrum sclerotized, ventral plate quadratic-lyriform, dorsal plate discoidal, granulously sclerotized. Ductus bursae twisted at posterior third. Appendix bursae long, cylindrical, strongly rugose. Corpus bursae elliptical-ovoid, membranous, with four signum-stripes.

Orohadena (Bryohadena) nekrasovi sp. n.
(Figs 15, 29, 30, 38)

Holotype: male, Tadjikistan, Pamir, Vanchskiy hrebet, lednik [= glacier] Lyangar, 4000 m, 26.7.1962, leg. YU. SHCHETKIN, slide no. 930 GYULAI (coll. P. GYULAI, deposited in HNHM, Budapest).

Paratypes. Tadjikistan: 2 males, with the same data as the holotype (coll. GYULAI and G. RONKAY); 1 female, Pamir, Gunt, riv. Okmamad, 3000 m, 18.VII.1982, leg. SHCHETKIN (coll. GYULAI); 1 female, Vanch, Gushon, 2000 m, 16–23.7.1990, A. LINDT leg. (coll. ZMU Helsinki); 1 male, NW Pamir, Rushan, 70 km NE Khorog, Gormo, 3500 m, 9.VIII.1996; 1 male, from the same locality, 16–17.VIII.1996 (coll. HREBLAY).

Slide Nos 846 GYULAI, HM8989 HREBLAY (males), RL6512 (female).

Diagnosis: The species is rather remote from the other taxa of the *Pseudohadena* (s.l.) complex, resembling externally mostly to certain species of the genus *Bryopolia* BOURSIN, 1954, or to some groups of the *Polymixis* HÜBNER, [1821] generic complex (e.g. the *zophodes*-group or the *Eremophysa* BOURSIN, 1958 species). The male genitalia of *O. (B.) nekrasovi* differ from those of *O. (O.) presbytis*, *O. (O.) clementissima* and of *O. (O.) xanthophanes* by their less elongate, medially dilated valvae with smaller, much narrower, less pointed cucullus and shorter corona, longer, finer, more pointed harpe and costal extension and by the different armature of vesica having small, wide-based medial cornutus and a small bundle of spinules terminally while the related three taxa have a rather strong terminal cornutus. The male genitalia are also similar to those of the taxa of *Eremophysa* or the *Polymixis shensiana* (DRAUDT, 1950) – *P. mandschurica* BOURSIN, 1970 species-pair but the cucullus is smaller, without dense covering of hairs, the costal lobe is less expressed, not acute as in *Eremophysa*, the harpe is essentially stronger, longer, curved, the costal extension is considerably longer, more acute, the carina is unspecialized, the vesica has only a small, wide-based medial cornutus besides the terminal bundle of spinules, etc.

Description: Wingspan 42–47 mm, length of forewing 20–23 mm. Male. Head small, eyes large, globular, frons broad, smooth. Palpi slender, upturned, covered with scales, antenna ciliate with long, fasciculate cilia. Pubescence of head and thorax dense, long, rather homogeneous, dark greyish green mixed with ochreous hair-scales, tegulae less distinct, metathoracic tuft small. Forelegs without tibial or basitarsal spines. Forewing elongate, rather narrow triangular with apex acute, outer margin evenly arcuate. Ground colour dark greyish green, irrorated strongly with pale ochreous, basal area with bluish green. Wing pattern strong but rather diffuse, ante and postmedial crosslines waved, broad, simple, dark green-grey, defined with wide ochreous zone. Basal line a strong grey-brown patch, median area rather narrow, tapering strongly below cell, darkest area of wing, median fascia represented by broad, obsolescent, green-grey shadow. Subterminal line obsolescent, interrupted, ochreous-whitish, defined by a few diffuse, small dark patches. Orbicular stigma small, rounded, filled with ochreous, reniform stigmata rather narrow, lunulate, dark green-grey, defined by indistinct whitish-ochreous annulus; claviform absent. Terminal line less conspicuous, fine, brown,

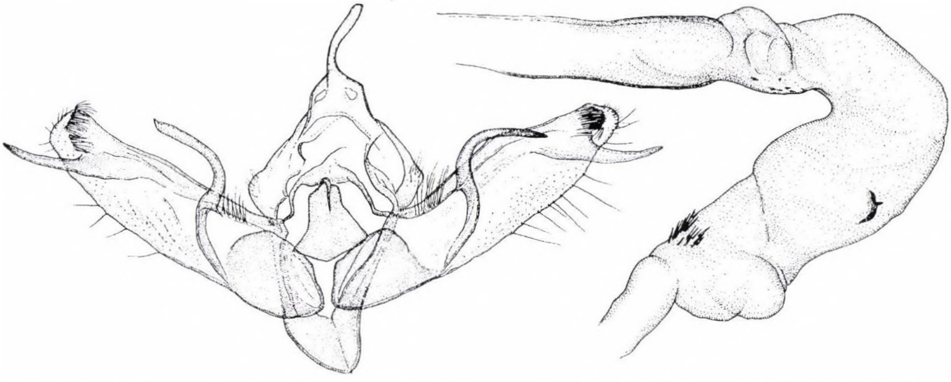


Fig. 29. *Orohadena (Bryohadena) nekrasovi*, sp. n., holotype, genital capsula and aedeagus with vesica everted

cilia ochreous, variegated with darker green-grey. Hindwing small, rounded, suffused with dark greyish brown, veins and long, lunulate discal spot even darker, transverse line diffuse, ochreous. Terminal line indistinct, dark brown, cilia ochreous. Underside of wings pale ochreous grey, forewing suffused, hindwing irrorated with darker brownish grey, transverse line and discal spot present on both wings. Female. As male, hindwing somewhat darker, antenna filiform.

Male genitalia (Figs 29–30): uncus relatively short, distally slightly dilated, with apex finely spatulate. Tegumen broad, rather low, penicular lobes small, weak. Fultura inferior subdeltoidal, with fine medio-apical crest, vinculum short, strong, more or less V-shaped. Valva long, medially dilated, costal margin finely convex at middle. Costal extension very long, strong, acute, more or less straight or finely curved Cucullus short, often slightly asymmetrical, rounded triangular or rounded quadrangular, apex less ponted, corona weak, short. Sacculus short, sclerotized, clavus less developed, harpe strong, long, slender, curved at middle, apex more or less pointed. Aedeagus cylindrical, ventral part of carina with sclerotized plate. Vesica tubular, membranous, basal part narrower, medial

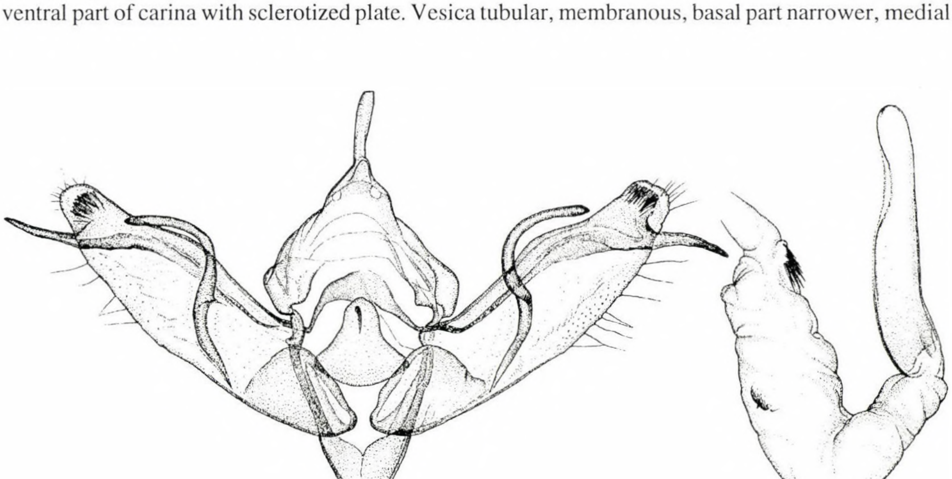


Fig. 30. *O. nekrasovi*, sp. n., paratype, genital capsula and aedeagus with vesica everted

part upturned dorsally, distal part broadened, recurved, finely scobinate, armed with a very short, wide-based, pointed cornutus, terminal part with small bundle of short spines and with semiglobular, small diverticulum at opposite side.

Female genitalia (Fig. 38): ovipositor conical, rather short, papillae anales weakly sclerotized, apically rounded, setose; posterior and anterior gonapophyses short, slender. Ostium bursae sclerotized, flattened, ventral plate quadratic-lyriform, with concave caudal margin, dorsal plate smaller, discoidal, granulously sclerotized. Ductus bursae tubular, long, flattened, twisted at posterior third. Both surfaces sclerotized except posterior end, anterior end with long, sclerotized crests extending towards appendix bursae. Appendix bursae long, cylindrical, moderately sclerotized, strongly rugose, apical part semiglobular. Corpus bursae elliptical-ovoid, membranous, with four medium-long signum-stripes.

Bionomics and distribution. The species is known by a few examples from Tadjikistan, most of them were collected at the high altitudes of the Pamir Mts (Wakhan, Lyangar). The moths are on wing during the summer period.

Etymology: The new species is dedicated to Mr ANDREI VLADIMIROVICH NEKRASOV (Moscow).

Heterographa thoenyi sp. n.
(Figs 16, 31, 39)

Holotype: male, "S-KASACHSTAN, Kzyl-Orda, 170m, 1.5.1993, leg. Danilevsky, coll. Thöny", slide No. RL6137 (coll. HNHM, Budapest).

Paratypes: 2 males, 2 females, with the same data as the holotype (coll. HNHM Budapest and G. RONKAY). Slide No. RL5913 (female).

Diagnosis. The new species has a curious external appearance within the genus, resembling slightly only to *H. tetrastigma* BRANDT, 1941, but the forewing is more unicolorous, without dark suffusion in the basal and medial areas, the basal dash is conspicuous, long, black, darkest marking of the wing. The crosslines of *H. thoenyi* are weaker, more diffuse, the orbicular and claviform stigmata are smaller, less defined, the reniform is larger, more elliptical, the subterminal is reduced to a few dark chevron-marks and the hindwing is generally darker, whitish grey with rather homogeneous darker suffusion in the marginal area, the discal spot is larger, more or less rounded, and the cilia is greyish, not clear white.

Description. Wingspan 28–30 mm, length of forewing 13–15 mm. Sexes similar. Head small, eyes large, globular, frons smooth, palpi slender, upturned, antenna filiform. Pubescence of head and thorax short, scale-like, dark grey mixed with whitish and a few brown scales, tip of collar and edges of tegulae marked with dark brown and whitish scales. Metathoracic tuft small, whitish grey, forelegs without tibial or basitarsal spines. Abdomen slightly paler, more greyish, dorsal crest present, consisting of small whitish grey tufts with darker tips, venter whitish grey. Forewing rather narrow triangular with apex finely pointed, cilia slightly crenulate. Ground colour shining, rather pale fumous

grey, evenly irrorated with dark brownish grey and pale ochreous scales. Wing pattern rather distinct although not very conspicuous, basal dash very long, black, extending towards tip of claviform. Antemedial line obsolescent, sinuous, angled strongly outwards near inner margin, postmedial line sharper, sinuous, double, blackish grey filled with whitish. Median fascia absent, subterminal line interrupted, fine, whitish, defined with a few blackish chevron-marks. Stigmata present, finely encircled with blackish grey and whitish, filled with ground colour and with a few darker grey scales. Orbicular small, rounded, reniform large, more or less drop-shaped; claviform as large as orbicular, its lower side defined also with distal end of basal dash. Terminal line a row of dark brown spots, cilia as ground colour, variegated with darker brown. Hindwing pale whitish grey, marginal area suffused with darker grey-brown. Discal spot large, rounded, dark brown-grey, transverse line pale, poorly visible. Terminal line blackish brown, cilia whitish, weakly spotted with darker grey. Underside of wings whitish grey, irrorated with dark grey and brownish scales, traces of transverse lines, orbicular and reniform stigmata and discal spot dark grey-brown.

Male genitalia (Fig. 31): Uncus short, flattened, cuneate, tegumen narrow, weak, penicular lobes small, narrow. Fultura inferior rather weak, basal plate small, deltoidal, apical plate long, nar-

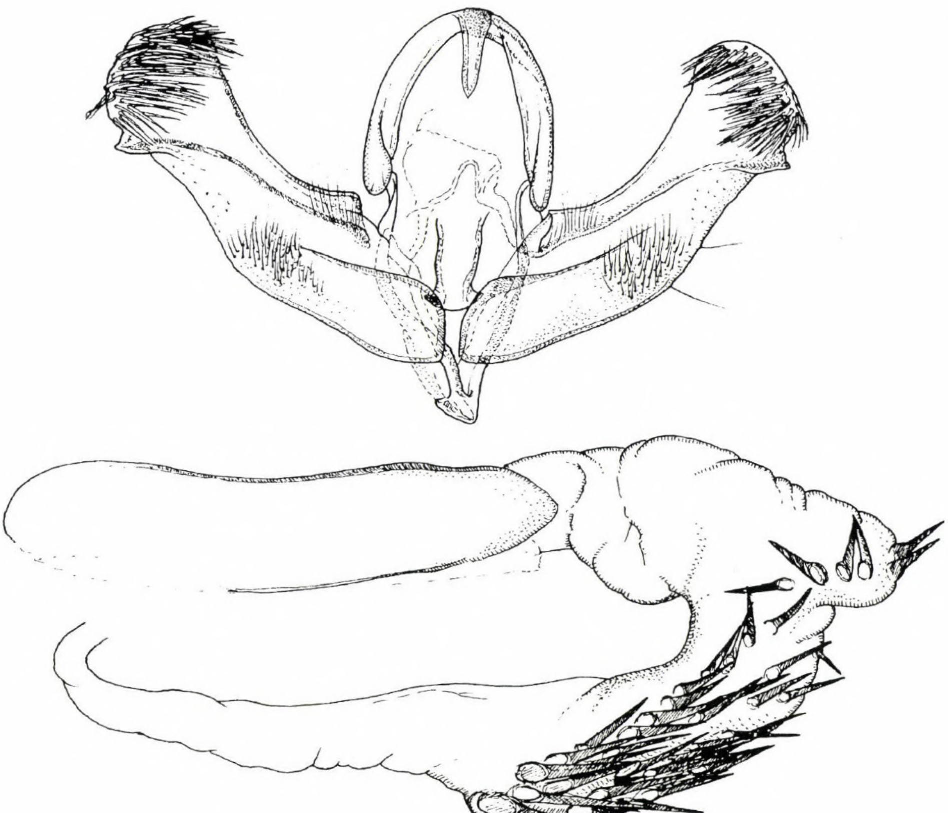
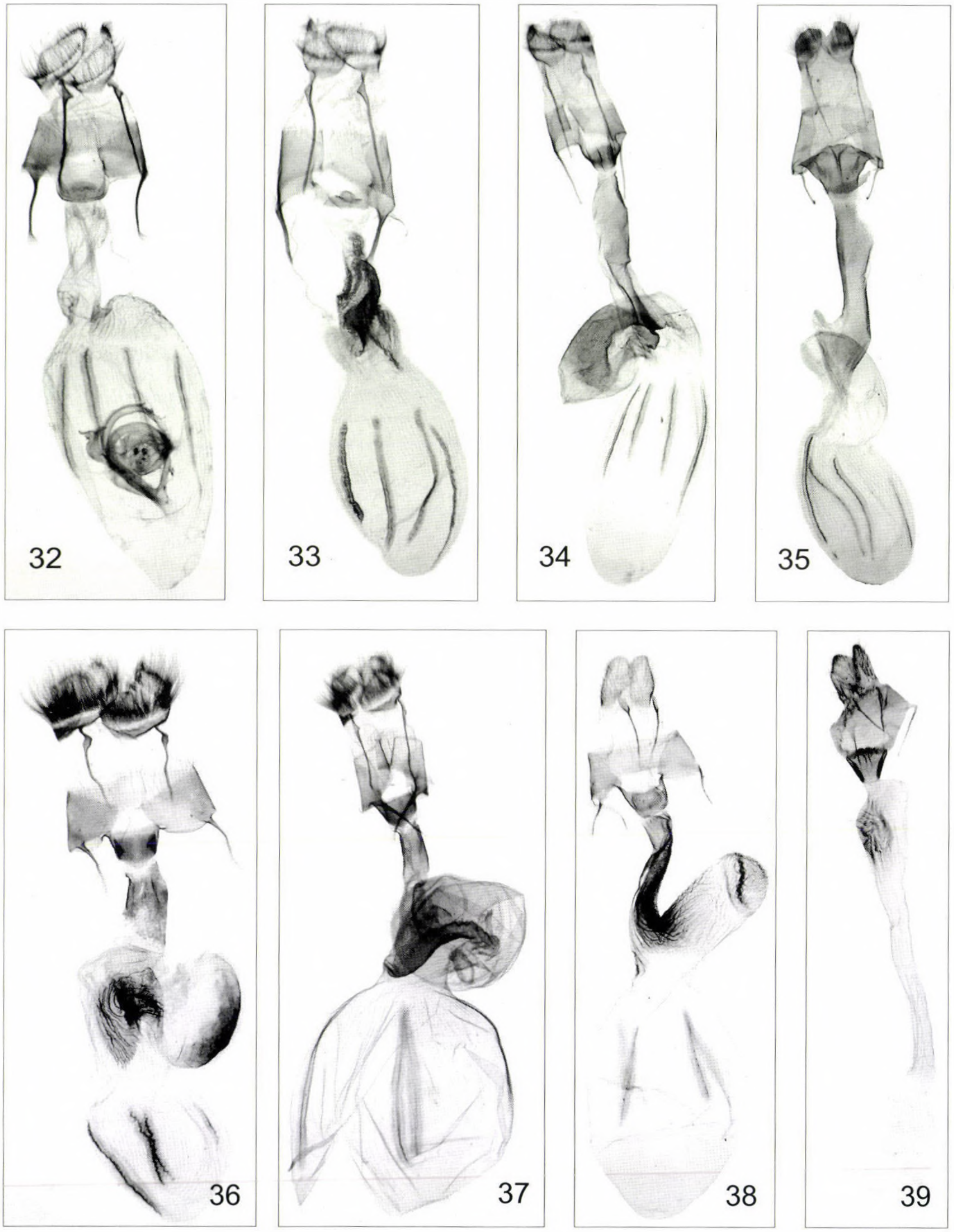


Fig. 31. *H. thoenyi*, sp. n., holotype, genital capsula and aedeagus with vesica everted



Figs 32–39. Female genitalia: 32 = *Pseudohadena albilacustris*, sp. n., paratype; 33 = *Eremohadena catalampra*, sp. n., paratype; 34 = *E. (Megahadena) immunis*; 35 = *E. (M.) megaptera*; 36 = *Orohadena (Orohadena) cardinalis*, sp. n., holotype; 37 = *O. (O.) xanthophanes;* 38 = *O. (Bryohadena) nekrasovi*, sp. n., paratype; 39 = *Heterographa thoenyi*, sp. n., paratype

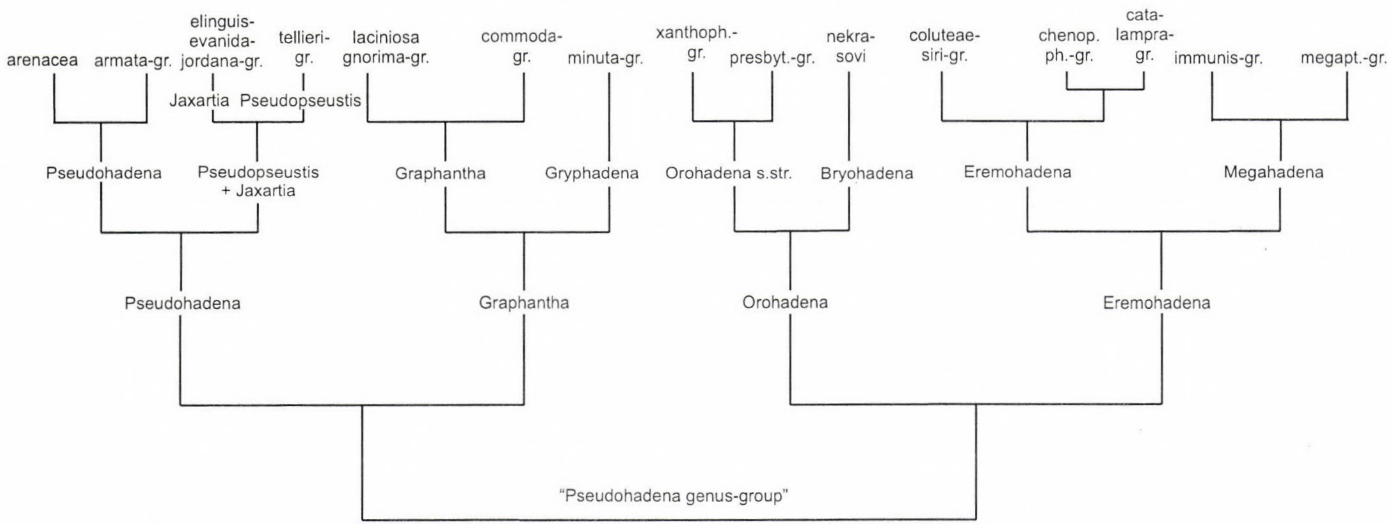


Fig. 40. The cladogram of the supraspecific taxa of the *Pseudohadena* generic group

rowly quadrangular, vinculum short but strong, V-shaped. Valva elongated, slightly constricted medially, cucullus large, broadened, rounded quadrangular with apex rounded; corona represented by large field of long, strong bristles. Sacculus long, narrow, sclerotized, distal end with densely setose field along ventral margin; clavus forming sclerotized, elongate, sparsely setose lobe. Harpe reduced, costal extension sclerotized, broad but short, triangular, with apex finely pointed. Aedeagus cylindrical, ventral part of carina forming stronger, beak-shaped plate with small, curved apical process. Vesica broadly tubular, everted forward, distal part recurved laterally on left side. Proximal part membranous, finely scobinate, with two small, dorsal diverticula and with semiglobular apical diverticulum bearing a few strong, acute cornuti. Distal part armed with numerous strong, acute cornuti arranged into two fields, their size increasing towards distal end of vesica. Ventral field much longer, dorsal field short, cornuti of latter larger in average; terminal part of vesica strongly scobinate.

Female genitalia (Fig. 39): Ovipositor short, conical, papillae anales elongate, pointed, weak, 8th segment forming narrow, sclerotized ring ventrally; both pairs of gonapophyses long, slender. Ostium bursae sclerotized, trapezoidal, tapering proximally, lateral margins folded, caudal end arcuate, with small, rounded, medially slightly incised lobe. Ductus bursae very short, reduced to fine membranous neck, cervical part of bursae copulatrix (appendix bursae) very long, cylindrical, scobinate, with small, subconical caudal end terminated in ductus seminalis; postero-lateral third strongly ribbed and more scobinate, proximal two-third narrower, tapering towards corpus bursae. Corpus bursae rather small, elliptical-ovoid, membranous with fine scobination; signa absent.

Bionomics and distribution. The species is known from the type locality only, all examples were collected at light at the same night. This period represents in that area the late spring-early summer aspect, depending on the year. The collecting habitat is unknown, the main habitats in the vicinity of Kzyl-Orda are dry, open steppes, semi-deserts mixed with anthropogenic areas.

Etymology: the new species is named after Mr HUBERT THÖNY (Poté, Brasil), a dedicated collector of Noctuidae, specialist of the subfamily Plusiinae.

*

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EARLY-SPRING FLOODS DECREASE THE SURVIVAL OF HIBERNATING LARVAE OF A WETLAND-INHABITING POPULATION OF NEPTIS RIVULARIS (LEPIDOPTERA: NYMPHALIDAE)

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The effect of early-spring submergence on larvae of a wetland-inhabiting population of the butterfly *Neptis rivularis* (SCOPOLI, 1763) (Nymphalidae: Neptini) was investigated in laboratory. Wild-collected, late hibernation larvae originating from inundated marshes of the Třeboň Basin (Czech Republic) were exposed to two conditions possibly experienced during the floods, aerated (as under running water) and anoxic (as in still water). Submergence for up to three days did not affect larval survival; longer submergence caused substantial mortality, no larva survived the longest submergence tested (21 days). Since there were no differences between aerated and anoxic treatments, the mortality seemed to be due to a failure of osmotic balance. Very short submergence thus does not influence larval survival in field, but prolonged floods may substantially reduce population size. However, the extent of the floods varies in the years, there are some upland colonies of *N. rivularis* in the area, and the butterfly is a relatively good disperser. It is thus assumed that the species compensates for inundation-caused mortality by a re-colonisation of its sites.

Key words: butterfly, floodplain ecology, inundation, larval dormancy, population dynamics, survival, winter mortality

INTRODUCTION

Awareness of continuing degradation and decline of wetland habitats throughout the world have sparked interest in conservation-oriented studies of wetland biota, including invertebrates (BATZER & WISSINGER 1996). In this context, habitat requirements, population dynamics and other conservation-related issues of wetland Lepidoptera were studied (e.g. DEMPSTER 1995, FISHER *et al.* 1999, WETTSTEIN & SCHMID 1999, SPITZER *et al.* 1999, WEBB & PULLIN 2000). Several authors addressed direct questions related to management and/or restoration of habitats of threatened wetland species (e.g. PULLIN *et al.* 1995, DENNIS & EALES 1997), including the effects of periodic winter- and early spring floods on the survival of hibernating Lepidoptera larvae. Such floods, causing in some instances

long-term submergence of entire habitats, are undoubtedly among the most prominent physical factors affecting population dynamics of wetland species. This might be especially important in case of insects, since their dormant developmental stages cannot avoid submergence by leaving the flooded space.

Impacts of winter or early spring submergence on butterfly larvae have so far been investigated in detail in case of two European species, *Coenonympha tullia* (HAWORTH, 1803) (Nymphalidae: Satyrinae) and *Lycaena dispar batavus* (OBERTHÜR, 1923) (Lycaenidae). The former butterfly showed substantial decrease of survival even after short submergence (JOY & PULLIN 1997, 1999), while the latter species withstands prolonged submergence (up to 28 days) without decline in survival, depending on timing of flood relative to that of diapause (WEBB & PULLIN 1998). In addition, survival of floods was affected by predation pressure (WEBB & PULLIN 1996) and varied in populations of different origin (NICHOLLS & PULLIN 2000). Clearly, flooding affects populations of the two wetland-inhabiting butterflies in entirely different ways and it is desirable to study the impact of this important ecological factor in a wider range of wetland species.

We studied in laboratory the effects of early-spring inundation on hibernating larvae of a wetland-inhabiting population of the butterfly *Neptis rivularis* (SCOPOLI, 1763) (Nymphalidae: Neptini). Two conditions possibly experienced by the larvae, which may differ in impact on their survival, were simulated. These were 1) aerated condition, likely to prevail in the beginning of flood and/or at waterside sites communicating with running water; and 2) anoxic condition, which may prevail in pools of still water in late days of floods. In addition, we present the map of distribution of *N. rivularis* in the area of interest, and discuss relation of the species' distribution to the extent of inundated areas.

MATERIAL AND METHODS

Neptis rivularis is widely distributed in the southern part of Palaearctic region, in a long belt that stretches from Japan to Central Europe. At the western margins of its distribution, it has restricted and often insular distribution, ascending upstream major rivers and reaching Upper Austria and Switzerland (LEPIDOPTEROLOGEN ARBEITSGRUPPE 1987). In the Czech Republic, it is restricted to the wetland habitats of the Třeboň Basin, Southern Bohemia, which is a flat and humid area of marshes, floodplain forests, peat bogs, fishponds and wet meadows. Owing to its restricted distribution in the country and its local dependency on wetland habitats, it is considered as vulnerable at national scale and enjoys legal protection (NOVÁK & SPITZER 1982, SPITZER 1992).

The butterfly is univoltine, on the wing from June until August. The larvae develop on several species of the *Spiraea* shrubs, in the Třeboň Basin – and the entire Czech Republic – only on *Spiraea salicifolia* (L.) (SPITZER 1958, HLÁSEK & HLÁSEK 1997). Adults generally stay in the close vicinity of the shrubs; rich *Spiraea* inflorescences seem to be their principal nectar source. All local colonies are thus restricted to habitats of the shrub, i.e. to wet meadows, margins of fishponds and water channels,

riverbanks and sparse floodplain forests. Young larva overwinters in a hibernaculum (made out of partly eaten and silk-spun leaf of the foodplant) attached to a *Spiraea* twig by silken cord. The hibernacula are easily spotted on the shrubs in winter or early spring, when most of the other leaves already fell. HLÁSEK and HLÁSEK (1997) speculated that floods cause high mortality during hibernation, since *Spiraea* shrubs are especially abundant on sites affected by snowmelt floods (many of them are situated on the bottom of inundation embankments built for fishpond protection). At such localities, the water depth may reach several metres during flood culmination, and pools of still water often remain there for several weeks.

Submergence experiment

The hibernacula were collected at the Nová řeka Marsh, extensive periodically flooded sedge grassland along the Lužnice River (49°00'N, 14°53'E, alt. 430 m; Fig. 1). At this locality, extensive growths of *Spiraea salicifolia* host the largest of *N. rivularis* colonies in the Třeboň Basin. In February 2000, 180 hibernacula were collected and kept at outdoor-simulating conditions (constant 5°C) until mid-March, i.e. when spring floods usually inundate the locality.

Prior to the experiment, the hibernacula were randomly divided into 9 groups of 20 individuals, which were put into Petri dishes with lids replaced by loose mesh. The following treatments were applied: submergence to aerated water for periods of 3, 10 and 21 days ("aerated" treatment, 3 groups); submergence to anoxic water for the same periods ("anoxic" treatment, 3 groups), and 3 not-submerged controls. One of the control groups was brought into room temperature at the beginning of the experiment. The two remaining controls were kept at constant 5°C for another 21 days, i.e. for the duration of the longest submergence period, one of them on air and one under nitrogen atmosphere (Table 1). To avoid any damage to the diapausing larvae, we did not check their condition before commencing the experiment. Therefore, the actual number of larvae that were alive at the beginning of experiment might have been lower than the N = 20.

The Petri dishes with the "aerated" larvae were submerged, without removing the larvae from their hibernacula, to the bottom of a 3 liters jar filled with water aerated by an aquarium aerator to simulate conditions in a running river. The jar for the anoxic treatment was fully filled by water, from which air oxygen was reduced by boiling. Larvae of both aerated and anoxic treatments were submerged into their jars after the water had cooled down to 5°C. The "anoxic" jar was covered by pure nitrogen atmosphere, and sealed to prevent oxygen influx. Care was taken not to allow air bubbles to

Table 1. Numbers of surviving larvae and numbers of adult butterflies emerged, after submergence of hibernating larvae of *Neptis rivularis* at different submergence conditions

	No. surviving individuals			No. surviving individuals		
Surviving after	24 hours	10 days	adult ♂/♀	24 hours	10 days	adult ♂/♀
No submergence	Oxygen atmosphere			Nitrogen atmosphere		
Control 1 (0 days)	15	14	3/2			
Control 2 (21 days)	13	12	2/3	14	12	5/7
Submergence	Aerated water			Anoxic water		
3 days	17	12	3/4	13	12	6/3
10 days	4	4	2/1	7	7	–/4
21 days	0	0	–/–	0	0	–/–

remain in the Petri dishes. Constant low temperature (5°C) and a continuous darkness were maintained during the whole duration of the experiment.

After termination of respective submergence periods, the hibernacula were brought to room temperature, which activated the till-now dormant and motionless larvae. The hibernacula were carefully lifted from water and put individually to Petri dishes with tissue paper and a few fresh *Spiraea* leaves. After 24 hours, surviving larvae were counted. Larva was considered alive if it showed any movement. For subsequent days, we fed the larvae with fresh leaves of their foodplant and kept a high humidity in the dishes to avoid desiccation. As in WEBB and PULLIN (1998), we repeated the counting of surviving individuals in each group ten days after termination of submergence, to check a delayed post-submergence mortality. After the second check, we transferred the larvae individually into rearing cages, continued feeding them with fresh leaves and reared them up to maturity.

We were interested in the effects of time of submergence, and of the two different treatments, on larval survival. Since classical cross-tabulation testing would not allow reflecting possible higher-level interactions among the factors, the log-linear models (LLM) for multidimensional contingency tables (ZAR 1996) were applied for analyses. The LLMs express multi-way relationship among independent variables and their interactions in a linear fashion through logarithmic transformation. The analyses were done using the STATISTICA 5.1. package (STATSOFT 1995), using the programs' procedure of automatic model fitting, which first fits a model with no relationships between factors; then a model with all two-way interactions, and so on. After finding a model that fits the data, the program proceeds to eliminate all higher-level interactions that have no statistically significant effect on distribution of dependent variable (i.e., the counts of surviving larvae in individual groups). The resulting model is the one that includes the least number of interactions necessary to fit the observed situation. The default options for model selection were used: p(1) [minimum significance level on which the model sufficiently fits the data] > 0.1, p(2) [level of significance for individual terms to be included into the model] < 0.05, and Δ [the value added to each cell count to avoid zeros] = 0.5.

In reporting statistical significance of interactions between independent variables on fit of the models, two statistics are presented. Partial association χ^2 compares the fit of a model that includes all two-way interactions with the model that excludes the interaction of interest. Marginal association χ^2 compares the model that includes all main effects (i.e., all effects of lower order than the one of interest) with the model that includes the interaction between the factors of interest.

RESULTS

Distribution of N. rivularis

The butterfly inhabits patches of *S. salicifolia* at both inundated and upland sites in the Třeboň Basin (Fig. 1). The inundated sites generally adjoin major rivers, they often lie within flood regulation embankments. The upland sites are characteristic for sites with a higher level of ground water, i.e. on raised bogs and moorlands. This pattern is further complicated by planting of *S. salicifolia* as an ornamental plant: both hibernacula and adults of *N. rivularis* were found at planted hedgerows of *S. salicifolia* in the town Třeboň repeatedly for three consecutive years (1996–1998).

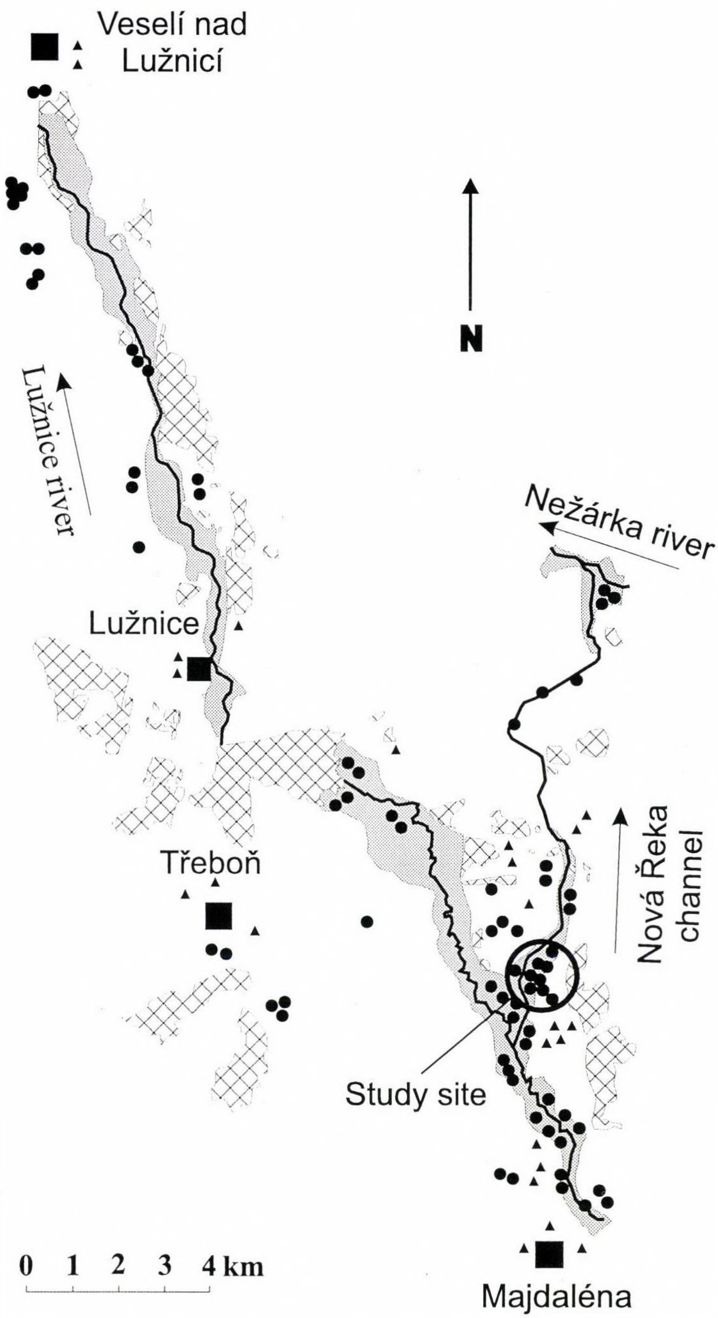


Fig. 1. Map of the central part of Třeboň Basin (along Lužnice river) with colonies of *Neptis rivularis* (●) and records of stray adults of the butterfly (▲), as encountered during 1996 season. The gray pattern indicate inundated areas, the light dashed area shows major fishponds

Virtually all growths of the shrub showed traces of presence of *N. rivularis*, such as the hibernacula, young larvae or empty pupal cases. Searching within the shrubs was extremely time-consuming due to their peculiar architecture; it was not feasible to quantify densities of pre-adult stages of *N. rivularis*. It was nevertheless clear that even several very small shrubs patches (ground cover ≈ 2 m^2, distance to the closest patches > 200 m, growing e.g. near drainage channels among cultivated fields) hosted larval hibernacula. It follows that we regard practically all patches of *S. salicifolia* in the area of interest as utilised by *N. rivularis*. This does not imply that there are well-defined adult colonies at all patches: in total, 24 stray butterflies were recorded over 500 meters away from the foodplant patches in 1996, suggesting relatively good dispersal ability of the species (Fig. 1).

Submergence experiment

In the three not-submerged controls (samples of 20 individuals), 71% (SD = 3.9%) of larvae showed signs of life when brought into room temperature (Table 1). Survival did not differ in the three controls (Pearson's chi square, $\chi^2 = 0.476$, d.f. = 2, $p = 0.79$) and did not decrease in any of the controls after 10 days following the treatment ($\chi^2 = 1.65$, d.f. = 2, $p = 0.98$). Thus, there was similar baseline mortality in the three controls and no delayed lethal effect after activation. Similar proportions of larvae survived 3 days of submergence (aerated: 85%, anoxic: 65%; aerated vs. anoxic: $\chi^2 = 2.13$, d.f. = 1, $p = 0.14$). The two groups did not differ in numbers of larvae surviving the first 10 days after activation ($\chi^2 = 0.23$, d.f. = 1, $p = 0.63$).

The number of surviving larvae sharply declined with prolonged submergence, and no larvae survived the longest submergence time; all larvae were dead and swollen after the 21-day treatment (Table 1). The LLM analysis which compared larval survival among the two treatments and 3 submergence periods revealed that the pattern was best described by the effect of time only (goodness of fit of the model: $\chi^2 = 1.28$, 6 d.f., $p = 0.97$). The effect of time on larval survival was highly significant (interaction survival:time, partial $\chi^2 = 28.02$, d.f. = 2, $p < 0.0001$; marginal $\chi^2 = 28.03$, d.f. = 2, $p < 0.0001$), whereas the anoxic and aerated treatments did not differ in their effects (partial $\chi^2 = 0.01$, d.f. = 1, $p = 0.94$; marginal $\chi^2 = 0.01$, d.f. = 1, $p = 0.94$).

Comparison of numbers of surviving larvae among the two treatments and the aerated and anoxic controls (21 days) confirmed that the submergence itself, rather than aerated or anoxic conditions, caused the larval mortality (goodness of fit of the model: $\chi^2 = 0.04$, d.f. = 4, $p = 0.99$). The difference in survival between the larvae submerged for 21 days and the non-submerged controls was, naturally, highly significant (partial $\chi^2 = 24.86$, d.f. = 1, $p < 0.0001$; marginal $\chi^2 = 24.87$,

d.f. = 1, $p < 0.0001$). On the other hand, the anoxic vs. aerated conditions did not affect larval survival neither in association with time (partial $\chi^2 = 0.02$, d.f. = 1, $p = 0.89$; marginal $\chi^2 = 0.03$, d.f. = 1, $p = 0.87$), nor in relation to the submergence or non-submergence (partial $\chi^2 = 0.00$, d.f. = 1, $p = 0.99$; marginal $\chi^2 = 0.01$, d.f. = 1, $p = 0.94$).

In total, 45 adults were reared until adult stage. Adult sex ratio did not differ from 1:1 ($\chi^2 = 0.18$, d.f. = 1, $p = 0.67$). Proportions of successfully emerged individuals (of the larvae that were still alive 10 days after activation) did not differ between aerated and anoxic treatments ($\chi^2 = 0.55$, d.f. = 1, $p = 0.46$).

DISCUSSION

Hibernating larvae of *N. rivularis* survived submergence in laboratory for up to three days without detectable decline in survival. Longer submergence caused substantial mortality, and no larva survived the longest period tested, i.e. 21 days. In constant 5°C temperature, there was no difference in mortality between the groups submerged in aerated as opposed to anoxic water. Thus, very short inundation periods would probably not influence larval survival in the field, under either running or still water, but a prolonged flood may cause substantial reduction of population size.

The nature of the injury causing mortality in the larvae was not clearly determined in this study. However, we expect that the mortality was not caused by anoxia – an impossibility of respiration of aerial oxygen. This assumption is supported by two observations: mortality did not differ between aerated and anoxic submerged conditions, and it was not increased under nitrogen atmosphere (not submerged) in comparison to the untreated control and air control. The volume of the experimental jars was big enough to dilute possible waste metabolites, so that the larvae were not poisoned by them. The only plausible explanation we suggest is a failure of osmotic balance, in other words, uncontrolled intake of large amount of water into the body through the cuticle.

Our results confirm previous observation by HLÁSEK and HLÁSEK (1997), who viewed floods as a serious mortality factor. *N. rivularis* is considerably less tolerant to flooding than one of the other two European butterflies studied so far, the Large copper (*Lyacena dispar batavus*), which would survive without substantial increase in mortality for 28 days, and presumably for longer (WEBB & PULLIN 1998). On the other hand, it is more tolerant than the Large heath butterfly *Coenonympha tullia*, which – unlike *N. rivularis* – showed significant increase in mortality after submergence as short as three days. However, the latter species re-

sponds to flooding by an active escape reaction, which is unlikely in larvae of *N. rivularis* encased in their hibernacula. Also, at least some individuals of *C. tullia* may survive for as long as 28 days of submergence (JOY & PULLIN 1997), but no such case was detected in *N. rivularis*. Finally, we did not find – unlike of *C. tullia* but similarly to *L. dispar batavus* – an evidence for a delayed mortality at activating conditions of previously submerged larvae, suggesting that larvae that survive a flood may normally reach their maturity. *N. rivularis* is thus, with respect to winter flooding, intermediary between the two other species.

The differences in survival among the three wetland-inhabiting species correspond relatively well with character of their habitats. In the lowland fens of Britain and Netherlands, prolonged winter floods are a rule and the populations of *L. dispar batavus* that occupy such sites are likely to be adapted to them. On the other hand, winter floods are not regular phenomena at British habitats of *C. tullia,* i.e. upland moors: in the studies of JOY and PULLIN (1997, 1999), flooding of moorland sites was human-induced as a restoration practice. Colonies of *N. rivularis* in the Třeboň Basin are found at sites with the both inundation regimes, and some of the colonies are never flooded. Moreover, the species is found at many habitat types throughout its wide Palearctic range, including forest-steppes, and feeds on several species of *Spiraea*, some of which are not restricted to wetlands (cf. NICULESCU 1965, MURZIN 2000). Therefore, some populations of *N. rivularis* may normally not experience inundations. Since it was shown that populations of wetland butterflies of different geographical origin may be differently adapted to flooding (NICHOLS & PULLIN 2000), we expect that populations of *N. rivularis* from non-wetland habitats would less tolerate water submergence.

It should be noted that the larval mortality observed in our experiment does only weakly reflect the real situation in the field. Since the foodplant of *N. rivularis* may reach considerable height (up to 3 metres) at some localities, a natural anti-flooding defence for the larvae would be to hibernate in the upper parts of *Spiraea* shoots. On the other hand, hibernating too high on *Spiraea* branches would expose the larvae to increased predation by insectivorous birds. HLÁSEK and HLÁSEK (1997) mentioned feeding specialisation of overwintering local blue tits on *N. rivularis* hibernacula. While collecting our experimental material (February 2000), we noted that about 50% of hibernacula were attacked by birds and the content was eaten out. The ability of birds to orientate themselves according to the leaf damage caused by lepidopteran larvae is well known (e.g. HEINRICH & COLLINS 1983, MURAKAMI 1999) and is expectable in *N. rivularis*, which offers easily accessible and detectable morsels for foraging birds. Predation pressure might even increase during floods, when only non-submerged food is available for birds. During a major flood in April 1996 we observed flocks of warblers foraging on the tops

of *Spiraea* branches, which were in these days only a few centimeters topping water surface. These circumstantial evidences suggest that larvae of *N. rivularis* hibernating at flooded sites have to seek a balance between two risks, predation and prolonged submergence. If we take into account that the floods vary among years in duration and intensity, it would follow that the larvae hibernating in intermediate heights should have the highest survival when averaged among years. This hypothesis should be testable by manipulative field experiments.

At the floodplain sites of the Třeboň Basin, the early spring floods do not occur every year, and both extend and duration of flooding varies among sites and years. Adult butterflies have relatively long flight period (SPITZER 1958) and, judged from the records of stray individuals, considerable dispersal ability. These facts, and relatively close "clustering" of *N. rivularis* habitats, should assure that major hostplant sites are easily recolonised if a major flood transitionally destroys some local colonies. Our results point to possibly large diversity of anti-flooding adaptations of wetland inhabiting butterflies, ranging from inundation tolerance in sedentary, closed populations of *Lycaena dispar batavus*, to a low tolerance, but considerable dispersal and recolonisation ability in *Neptis rivularis*.

*

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OBSERVATIONS ON THE OVIPOSITING STRATEGY OF GORTYNA BORELII PIERRET, 1837 (LEPIDOPTERA, NOCTUIDAE) IN A BRITISH POPULATION

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The main British population of *Gortyna borelii* occurs on the north Essex coast, on sites very close to sea level. During 1999, 2000 and 2001, ovipositing strategies of *G. borelii* were studied providing details of egg laying behaviour, preferred oviposition host plants, height of ova deposition and distance of the oviposition site from the nearest larval food plant (*Peucedanum officinale*). Six oviposition host plants were identified, five of which were grass species: 75% of the observations were on *Elytrigia atherica* and *Elytrigia repens* with the female depositing eggs between the grass inflorescence and the outer leaf sheath. Sites with the highest incidence of oviposting females were dominated by long, coarse grasses (>75% of ground cover mainly *Elytrigia* spp.) and a sparse distribution (<25% of ground cover) of *Peucedanum officinale*. Surface morphology, size and shape of ova were described using scanning electron microscopy. The results of the study are important in the conservation of the species in the United Kingdom.

Key words: behaviour, *Gortyna borelii*, habitat, moth, ova, oviposition, sea level rise

INTRODUCTION

Fisher's Estuarine Moth *Gortyna borelii* PIERRET 1837 has a very limited distribution in the UK (HEATH & Emmet 1983, GIBSON 2000), restricted mainly to the Walton Backwaters area of north Essex in southeast England. The species has a widespread but localised European distribution and has been recorded in many countries in Central and Southern Europe (IPPOLITO & PARENZAN 1978, NOWACKI & FIBIGER 1996). *Gortyna borelii* is a large noctuid with a wingspan of 50–60 mm (IPPOLITO & PARENZAN 1978), and was first identified in Britain in 1968 (FISHER 1971). The sole larval food plant of the moth is *Peucedanum officinale* LINNEAUS, 1753 (Hog's fennel) in the United Kingdom, but it will feed on other species of *Peucedanum* in continental Europe (GYULAI 1987, DUMONT 1925–1926) and has been reared in captivity on other members of the Apiaceae (CHALMERS-HUNT 1972, GOATER 1973). In the United Kingdom, *Peucedanum officinale* is a plant of coastal grassland and its distribution is limited to two main localities: the north Essex coast around the Walton Backwaters area and the north

Kent coast between Faversham and Reculver (RANDALL & THORNTON 1996, WIGGINGTON 1999). *Gortyna borelii* is listed as Category 2 (Vulnerable) (SHIRT 1987) in the British Red Data Book, and is protected under Schedule 5 of the Wildlife and Countryside Act 1981 (GIBSON 2000). *Peucedanum officinale* is also included within the British Red Data Book as Lower Risk (near threatened) (WIGGINGTON 1999).

The majority of the British population of *G. borelii* occurs on coastal grassland, at <2 m above mean sea level. In continental Europe, however, the species is found within a diversity of habitats (GYULAI 1987, BUSCHMANN 1998–1999, STEINER 1998, KÖNIG 1959) and to altitudes of 1000 m (GYULAI 1987). In the United Kingdom, the habitat of *G. borelii* is particularly vulnerable to inundation by the sea as a result of rising sea levels. Sea levels are predicted to rise around the coasts of Britain by about 5 cm per decade as a result of climate change (CLIMATE CHANGE IMPACT REVIEW GROUP 1996). PETHICK (1993) also suggests that tectonic subsidence is accounting for a further relative sea level rise of 4–5 mm per year on the coast of Essex. The extinction of a *G. borelii* population in a river area (Necker Valley) in Germany is thought to be a result of prolonged flooding (STEINER 1985). To secure the long-term future of *G. borelii* in Britain it has been proposed to establish colonies further inland (GIBSON 2000), away from the dangers of sea level rise. There are, however, still many aspects of the life history and habitat requirements of this species that need to be understood before new colonies can be established. One of the most fundamental aspects is to determine the oviposition requirements and preferences of the species.

The flight period of *G. borelii* occurs from the beginning of September to the end of October and the moth diapauses in the egg stage, hatching the following spring (mid April to early May) – a period of 7 to 8 months (KÖNIG 1959). *Gortyna borelii* has been recorded ovipositing on dead grass stems in the UK (PLATTS 1981) and in Germany (STEINER 1998). However, the species of grass on which ovipositing was observed, the actual location of eggs on the plant or details of the process of oviposition were not, however, recorded by these authors. Other species of the same genus, *Gortyna flavago* DENIS et SCHIFFERMÜLLER, 1775 and *G. xanthenes* GERMAR, 1844, lay their eggs directly onto the larval food plant (IPPOLITO & PARENZAN 1978). *Gortyna borelii* has also been observed ovipositing directly onto its larval food plant (STEINER 1998, LÁSZLÓ RONKAY pers. comm.). The closely related species *Hydraecia immanis* GUENÉE, 1852 and *Hydraecia micacea* ESPER, 1789 are known to lay their eggs between the stem and outer leaf sheath of various grass species (FRENCH *et al.* 1973, DEEDAT *et al.* 1983, GIEBANK *et al.* 1984, LEVINE 1986).

RENWICK and CHEW (1994) suggest that oviposition behaviour and host acceptance in Lepidoptera can be reliant on a number of sensory cues, such as colour, texture, shape, and chemical stimulants. Furthermore, if the species lays eggs on plants, they generally have a preference for laying at a certain height (HINTON 1981). Also, factors such as temperature, relative humidity, wind and the time of the day are important for oviposition in many insects.

In previous papers, RINGWOOD *et al.* (2000, 2002) and HILL *et al.* (2002) have examined habitat characteristics of *G. borelii* and its larval food plant (*P. officinale*) in the United Kingdom and Germany. The objectives of the studies reported in this paper were to determine the preferred host plants for oviposition, the environmental requirements for ovipositing and the behaviour of *G. borelii* before, during and after oviposition. The studies also investigated the position of oviposition on preferred host plants and the distance of ovipositing from the nearest larval food plant. The results are discussed in terms of the conservation and management of the *G. borelii* population in the United Kingdom.

MATERIALS AND METHODS

The study was performed in 1999, 2000 and 2001 within the Walton Backwaters area of north Essex, UK. The area of study was approximately 95 hectares of coastal grassland, saltmarsh and scrub (*Prunus spinosa*). Stands of *Peucedanum officinale* grow in the coastal grassland between saltmarsh and scrub. Soil conditions and management of sites are reported in RINGWOOD *et al.* (2002).

To determine the incidence and location of oviposition in relation to habitat and vegetational structure, a transect route was set out in the area of study. The transect route incorporated all the main stands of *P. officinale* and other habitats found within the study area. The transect was divided into eleven sections of differing vegetational structure, habitat or density of *P. officinale*. A vegetation survey was carried out in each of these sections using a visual estimation of cover for each of the species present (BULLOCK 1996). The transect was walked twice a week during the flight period (beginning of September to end of October). At the start and finish of each transect survey details of the weather conditions, including air temperature, wind speed and cloud cover, were recorded. The transect was walked between 19:00 and 03:00 hours, and filtered torchlight (white light) was used to sight *G. borelii*. When ovipositing was observed, the plant species on which the moth was depositing her eggs, the height (cm) from ground, the distance from the nearest larval food plant (cm), the time of the observation and the transect section were recorded. Selectivity of host plant for ovipositing was assessed by χ^2 of observed and expected ovipositing events calculated from the incidence of potential host species for egg laying.

Behavioural observations were to evaluate the sequence of events preceding, during and subsequent to oviposition and also the length of ovipositing bouts. These observations were made twice a week during the flight period. Each behavioural observation period was approximately 2 hours in duration and performed between 19:00 and 06:00 hours. The behaviour was observed using filtered (white light) torchlight. At the start and end of each period, details of the weather conditions were recorded. The behavioural observation periods involved recording the time at the start and finish of

each bout of each behaviour observed (i.e. the duration of each period of resting, crawling, ovipositing, flying, grooming and wing movement). If a female was observed ovipositing the same details (*i.e.* plant species, height) as those recorded during the transect surveys were noted.

Scanning electron microscopy of a sample of *G. borelii* eggs, collected under licence from English Nature, was used to determine their size, morphology and surface texture. The eggs were prepared without fixation by sputter coating with gold in a Nanotech Semprep2. They were then scanned using a Hitachi S430 scanning electron microscope.

RESULTS

Eighty-four observations of ovipositing were made over the three years of monitoring; fifty-five during transect surveys and twenty-nine during the behavioural observation sessions. The species of plant on which *G. borelii* was observed laying eggs are shown in Fig. 1. Six oviposition host plants were recorded, five of which were grass species: *Elytrigia atherica*, *E. repens*, *Arrhenatherum elatius*, *Dactylis glomerata* and *Holcus lanatus*. Two oviposition observations were made on *P. officinale*, the larval food plant. The most frequently observed host plant for oviposition was *E. atherica*, with 52% of the total observations and *Elytrigia* spp. made up 75% of the observations. The majority (73%) of oviposition behaviour was made on dead inflorescences and pseudostems of grasses. *Gortyna borelii* showed strong selectivity in its host plant for ovipositing. There was an under representation of ovipositing on *Festuca rubra* and *P. officinale* in relation to the dis-

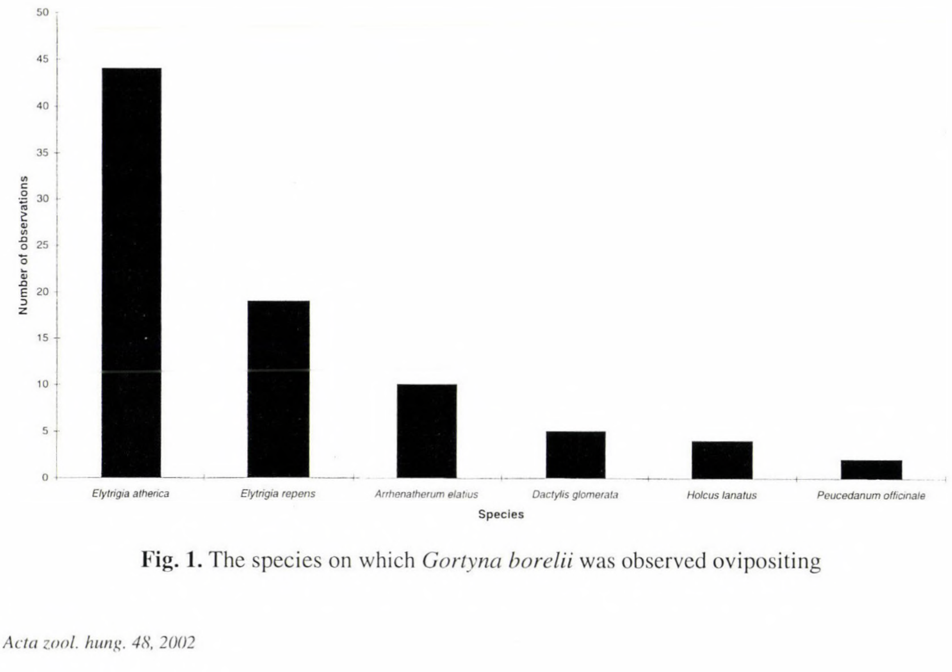


Fig. 1. The species on which *Gortyna borelii* was observed ovipositing

tribution of the two species of plant. Positive selectivity in ovipositing was observed for *Elytrigia* and *Arrhenatherum* as the incidence of ovipositing on these species was significantly greater than that expected (χ^2 (6 d.f) 61.3; P<0.001).

The requirements of *G. borelii* for a suitable species of grass for oviposition can be related to the vegetational structure of the areas where the most oviposition observations were made. The distribution of ovipositing was most frequent (66% of observations) in relatively sparse densities of *P. officinale* (<25% ground cover) with dense (>75%) ground cover of long, coarse grasses, characterised by *Elytrigia* spp. No oviposition observations were made within areas of scrub, saltmarsh, or grassland areas that supported a dense stand (>75% ground cover) of *P. officinale*.

Behavioural observations found that the female laid the eggs by probing with her ovipositor beneath the outer leaf sheath of the grass and depositing the eggs in a number of rows between the stem and the outer leaf sheath (Fig. 3). The eggs laid on *P. officinale* were deposited within a crevice in the stem axil of the plant. The ova are covered in mucus and are stuck to each other as well as to the stem. Over two hundred eggs were observed being laid in one batch. A typical ovipositing behavioural observation session is represented in Fig. 2. The period immediately before ovipositing is characterised by crawling, wing movement and resting bouts. The majority of the behaviour bouts observed both preceding (71%) and subsequent (68%) to oviposition were crawling. When the female is crawling, probing of suitable sites for egg laying is observed, however, the cue for egg deposition is

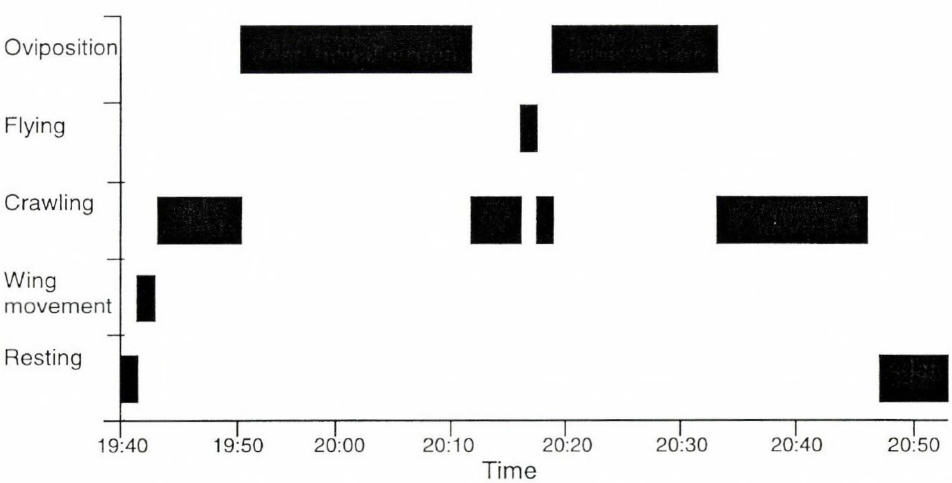


Fig. 2. Example ovipositing behavioural observation session

Table 1. Details of the oviposition characteristics of *Gortyna borelii*

	Mean±S. D.	Range
Air temperature during oviposition observations	14.1±1.8°C	10–18°C
Distance of ovipositing from the nearest food plant	30.0±29.6 cm	0–150 cm
Duration of oviposition bouts	15.6±11.7 mins	1–48 mins
Height at which oviposition was observed	43.8±13.5 cm	15–75 cm

not clear from the data collected. The duration of oviposition bouts ranged from 1 minute to 48 minutes in length (Table 1).

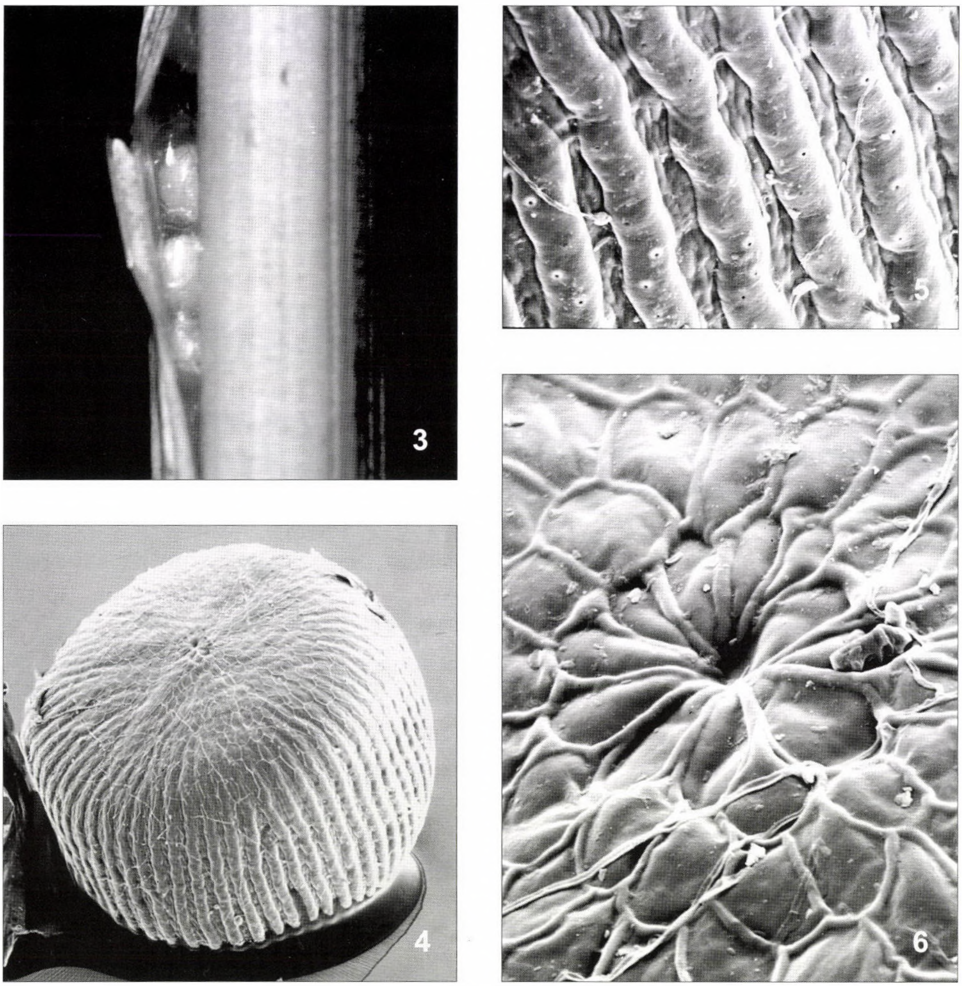
The time period when oviposition was recorded most frequently was between 19:00 hrs and 22:00 hrs. It appears, however, that ovipositing could occur at anytime between dusk and dawn. Furthermore, the majority of egg laying observations were made when the air temperature was around 14°C and *Gortyna borelii* was not recorded egg laying when the temperature was below 10°C (Table 1). The weather conditions most favourable to oviposition appeared to be still (<2 on Beaufort Scale), overcast, humid and relatively mild. The preferred height for oviposition by *G. borelii* was observed to be between 40 and 45 cm from the ground surface (Table 1). The distance of ovipositing from the nearest larval food plant ranged from 0 cm to 150 cm (Table 1). However, the majority of observations were made within 30 cm of the closest food plant.

Ova ultrastructure was examined using scanning electron microscopy (Figs 4–6). Ova are spherical in shape with a flattened top and base and the sides have a ribbed surface structure. Flattened eggs are often characteristic of Lepidoptera that glue their eggs together (SCOBLE 1995). The ova are approximately 700 μm in diameter and 350 μm in height. The ribbed surface structures on the sides of ova are perforated by numerous aeropyles (2–3 μm in diameter). The ribs are approximately 10 μm in width. The rosette-like sculpture (Fig. 6) of the chorion that surrounds the micropylar area at the anterior pole of the egg is characteristic of many species of Lepidoptera (SCOBLE 1995). The micropyle is about 6 μm in diameter.

DISCUSSION

An understanding of the ovipositing strategy and requirements of *G. borelii* are important for the successful management and conservation of the UK population. The results from this study suggest that *G. borelii* has a preference for ovipositing on *E. atherica*, then *E. repens* and *A. elatius* (Fig. 1) and not its larval food plant (*P. officinale*). Consequently, *G. borelii* does not appear to be oviposition

host specific. The preference for ovipositing on species of grass and not its larval food plant is similar to related species, for example *Hydraecia immanis* (GIEBANK *et al.* 1984, LEVINE 1986) and *H. micacea* (FRENCH *et al.* 1973). This strategy may provide an advantage to the moth as the stems of *P. officinale* do not provide a secure crevice within which the female can deposit her eggs. Any eggs laid onto *P.*



Figs 3–6. 3 = *Gortyna borelii* ova beneath the outer leaf sheath of a grass stem (Photo credit: MICKY ANDREWS). 4–6 = Scanning electron microscopy of *G. borelii* ovum (Photo credit: ZOE RINGWOOD): 4 = 700 µm diameter, 350 µm height; 5 = ribbed surface structure on the side of the ovum (ribs 10 µm in width, aeropyles 2–3 µm in diameter); 6 = micropylar area of the ovum (micropyle 6 µm in diameter)

officinale will therefore be exposed to the risks of predation and harsh winter weather conditions. This differs from the oviposition preferences of *G. xanthenes* and *G. flavago,* both species that lay eggs on their larval food plant (IPPOLITO & PARENZAN 1978). Consequently, the ovipositing characteristics of *G. borelii* in the United Kingdom appear to share more similarities with *Hydraecia* spp. than with species of *Gortyna*. However, where *G. borelii* occurs in forest steppe habitats in Hungary, the stems of the larval food plant appear to be the favoured oviposition site (LÁSZLÓ RONKAY pers. comm.). It is probable, as *G. borelii* occurs within a diversity of habitats across central and southern Europe, that the oviposition requirements of the species will differ from site to site.

Behavioural observations of *G. borelii* ovipositing followed a sequence of searching (crawling), surface texture evaluation (probing with the ovipositor) and finally acceptance by probing into an appropriate crevice (generally between the stem and outer leaf sheath of a blade of grass) and depositing the eggs. The host plants for ovipositing all, with one exception, have a relatively glabrous stem surface texture, the exception being *Holcus lanatus*. The dried grass stems chosen by *G. borelii* for oviposition are generally more resistant to decay during the winter, thus providing a secure niche for ova. All species of grass on which *G. borelii* was observed ovipositing, possess a loose outer leaf sheath, an ideal site for oviposition (a similar observation is noted with *Hydraecia immanis* (LEVINE 1986)).

As the preferred oviposition host for *G. borelii* is not the larval food plant in the United Kingdom, it could be suggested that the critical phase of the life cycle is the ability of freshly emerged larvae to migrate from over-wintering sites to the food plant. STEINER (1998) recorded *G. borelii* egg laying, in Germany, on grass stems up to 5 m away from the closest host plant. However, in the United Kingdom, distances of greater than 1.5 m have not been recorded, which may be due to the differences in environmental and vegetational conditions at sites in Germany and the UK (RINGWOOD *et al.* 2002). The ova are deposited in large batches, resulting in the likelihood that many neonate larvae will migrate to the same *P. officinale* plant to begin feeding. It is probable, however, that this migration accounts for a high level of mortality, with a substantial proportion of larvae being predated or not successfully locating a food plant. It is stated in HAGGETT (1981) that a maximum of just one pupa is found within each *P. officinale* rootstock, which suggests larvae either disperse a considerable distance from their hatching site or that a high level of mortality occurs during the larval stage.

The major requirement of the mated female is to recognise the most appropriate over-wintering habitat for the ova and the proximity of the habitat to the food plant. The density of the food plant and surrounding vegetation structure is therefore important in providing a suitable environment for ovipositing. The majority of

Table 2. The generalised phenology of *Gortyna borelii* and *Peucedanum officinale* in the UK

G. borelii	Time of year	*P. officinale*	Time of year
Ova	mid September–late April	Senescence	early October–mid February
Larva	late April–early August	Stem growth	mid February–mid June
Pupa	early August–early September	Flowering	mid June–early September
Adult	early September–mid October	Seed dispersal	early September–mid October

observations of ovipositing were in areas with a relatively low density of *P. officinale* and a high density of *Elytrigia* spp. There seems to be a clear selectivity for ovipositing on *Elytrigia* spp and *Arrhenatherum* and an under representation on *Festuca* and *Peucedanum*. The reasons for the observed selectivity may relate to an adaptation of the moth to the habitat in the UK (*i.e.* dense stands of *Elytrigia* spp.). However, the collapse of *Peucedanum* during the winter makes it a poor over-wintering site for ova and the morphology of *Festuca* may not be suitable as it precludes ovipositing when the leaf sheath is fused to the apex (STACE 1997).

The observed preferred height for oviposition by *G. borelii* (Table 1) corresponds with the part of the grass that supports a loose outer leaf sheath. The chosen height is above the zone of senescence and decomposition of leaf litter, but is low enough to be protected from harsh winter weather. Many of the sites that support *G. borelii* populations in Britain occur along sea walls, and as part of the maintenance of sea defences they are mown annually. If *G. borelii* requires grass of a certain height for oviposition, it is important to ensure that the cutting of grass will enable the grass to be at a suitable height for the moth during the flight period. Currently, much of the sea wall supporting populations of the moth is mown between the end of August and the beginning of September. This period coincides with the pupation/adult stage of *G. borelii* and the flowering/seed dispersal stage of *P. officinale* (Table 2). Therefore, not only is the current management regime detrimental to the emergence and flight of the adult moth, but it results in a short sward, far shorter than the observed average oviposition height (Table 1), being available to the female for oviposition. Also, the period of cutting is before seed dispersal stage of *P. officinale* (Table 2) thus reducing the recruitment rate of this plant.

Elytrigia atherica was the most frequently observed oviposition host and this species is found only within coastal habitats (STACE 1997). However, *G. borelii* was also observed ovipositing on four common grass species with a widespread distribution in the UK. Consequently, it is thought that the ovipositing requirements of *G. borelii* are not the reason why its British distribution is restricted to coastal grassland habitats in the southeast of England. The main reason for the re-

stricted distribution of *G. borelii* seems to be the local distribution of *Peucedanum*. This study provides important information for the proposed strategy of translocation of *G. borelii* colonies further inland in the UK, away from the danger of sea level rise.

*

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A LONG-TERM COMPARISON OF LAYING DATE AND CLUTCH SIZE IN THE RED-BACKED SHRIKE (LANIUS COLLURIO) IN SILESIA, SOUTHERN POLAND

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In this paper laying date and clutch size of breeding Red-backed Shrike *Lanius collurio* in two time periods (1905–1925 and 1985–1999) in southern Poland are compared. Comparisons were made on two separate data sets: a museum collection and nest-cards from the Polish Nest Record Scheme. No significant differences between time of laying (median was 26 May in both periods) and clutch size (5.01 vs. 5.06, respectively) were found. The possibility of using museum collections and nest-cards to analyse long-term trends in life-history traits is discussed.

Key words: *Lanius collurio*, climate change, long-term studies, museum collections, nest-cards

INTRODUCTION

Global warming, or climate change, is at present a popular subject and has been shown to affect birds. Studies have dealt mainly with changes in the geographic distribution of some species, their behaviour and migration pattern (BERTHOLD 1991, ŻELAKIEVIĆIUS 1997). However, recent studies have shown that climate change may also have beneficial effects on the reproduction of birds. Several authors have described changes in laying date and in clutch size linking these changes with an increase in temperature during the breeding period (CRICK *et al.* 1997, 1999, BROWN *et al.* 1999).

However, in most studies only data from the last 20–40 years are available. MEARNS and MEARNS (1998) suggested that better data sets might be obtained from museum collections.

In the current paper comparisons in laying initiation dates and clutch sizes of the Red-backed Shrike in southern Poland are presented. The hypothesis that, like other European species, the time of laying in Red-backed Shrike should be earlier in recent years and clutch size should also be bigger is tested.

METHODS

Two data sets from 1904–1925 and 1985–1999 were used. Only data from first clutches were included, i.e. replacement broods were omitted. Only clutches initiated before June 10th were considered as first clutches (after KUŹNIAK 1991 and similar to MATYJASIAK 1995).

Data from 1904–1925 were obtained from the oological collection of Muzeum Górnośląskie at Bytom. Most of the clutches were collected by E. DRESCHER (POTRZEBOWSKA-DUTKA 1969). For analysis, only clutches collected in the Opole Silesia and Upper Silesia regions were used. For describing clutch size parameters, details found on the museum labels were used. The problem was to establish the laying initiation date, which was only exceptionally given on the label. If unavailable, these were calculated from the information on incubation period as found on the labels. Only two kinds of information were used, whether the eggs were fresh or incubated (methods after SCHARLEMANN 2001). The blown holes of 20 fresh eggs and of 10 incubated eggs chosen at random were compared. Due to embryo development, the fresh eggs have, on average, a smaller hole than incubated eggs (1.72±0.24 *vs.* 2.49±0.48; $t=-5.9$, $p<0.0001$). In the case of clutches with fresh eggs (at least 70% of all analysed clutches) the laying initiation date was calculated as the collection date, as found on the label, minus the number of days equivalent to the clutch size + 1 (the margin for the collectors waiting for the full clutch). For incubated clutches the laying initiation date was calculated by taking the collection date minus the clutch size + 7 (half of the incubation period, OLSSON 1995, PANOW 1996). In total data from 73 clutches in the museum collection were used.

Data from the Polish Nest Records Scheme based on nest cards were used in the same way as other authors (MAYER-GROSS 1972, WESOŁOWSKI & CZAPULAK 1986, CRICK *et al.* 1993, MATYJASIAK 1995). Only in very rare cases was the information available directly from the nest-card. For others, the laying initiation dates were calculated assuming that birds lay one egg per day (OLSSON 1995, PANOW 1996), incubation starts from laying the last egg in clutches of 5 eggs or less or from the penultimate egg in larger clutches, and incubation lasts 14 days (OLSSON 1995, PANOW 1996, S. KUŹNIAK – unpubl. data). In rare cases information on nestling feather development, based on data from OLSSON (1995), was also used to establish the laying initiation date.

Data were split into two groups: (1) museum collection and (2) nest-record cards. Differences in breeding parameters were tested using t-test (clutch size), chi-square test (number of clutches with various number of eggs) and Mann–Whitney U-test and Kolmogorov–Smirnov test (timing of laying).

RESULTS

Number of nests

During 1904–1925 E. DRESCHER collected annually 4.6±4.9 (mean±SD) clutches, during 1985–1999 R. PIEŁA observed 4.8±2.7 nests ($t=-0.17$, $p=0.864$).

Time of laying

Between the years 1904–1925, the Red-backed Shrike laid the first egg between 1st May and 10th June (median 26th May).

Between 1985–1999 clutches were initiated between 9th May and 10th June (median 26th May). Differences in laying date between the two study periods were not significant (U = 2939, p = 0.297), nor was the difference in the distribution of the egg laying period (Fig. 1, Kolmogorov–Smirnov test, K-S Z = 0.61, p = 0.852).

Clutch size

In the first period, clutch sizes ranged from 2 to 6 eggs, and in the second period, from 2 to 7. Both results showed a similar pattern overall distribution (Fig. 2). The difference between mean clutch size in both periods (5.01±0.87 *vs.* 5.06±1.01, respectively) was not significant (t = – 0.31, p = 0.757).

DISCUSSION

Laying dates obtained by analyses of nest-cards are susceptible to biases if the observation intensity are not evenly spread over the breeding season. WESOŁOWSKI and CZAPULAK (1986) indicated that the highest proportion of searching activity by collaborators of the Polish Nest Record Scheme occurred during May. However, in June 90% of the collaborators that were active in May were still active. Therefore, there was no need to analyse the temporal differences between observ-

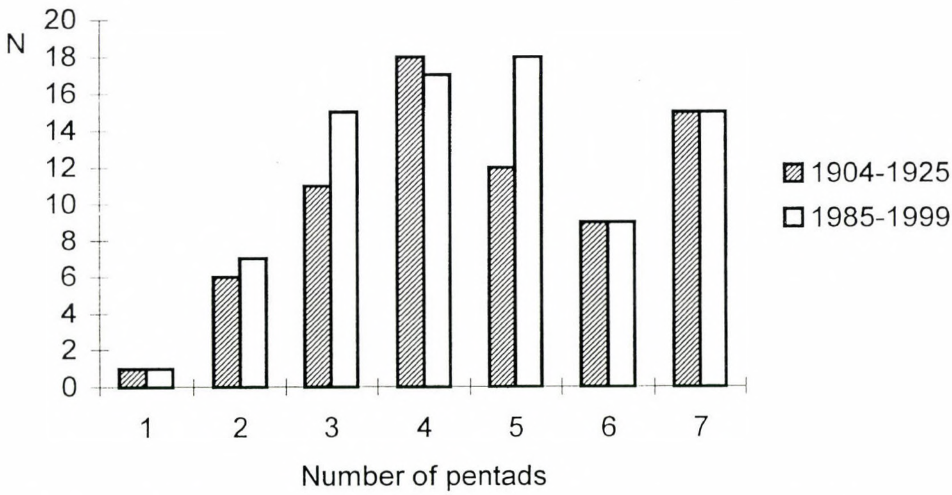


Fig. 1. The number of Red-backed Shrike clutches laid during successive five-day periods (1 = 6–10 May) in the two study periods. For sample size – see text

ers' activity in nest searching. Additionally, comparisons were made as accurate as possible because the two separate data sets were each collected by only one person, E. DRESCHER and R. PIEŁA respectively.

Data from nest-record cards were used in a similar way as for British birds (CRICK *et al.* 1993). Unfortunately, there is a lack of similar studies on old museum collections despite the fact that collectors provide good data and make useful comments for future analysis. In this paper, long-term data analysis was only made possible by the use of museum data.

The timing of laying and mean clutch size of the Red-backed Shrike in other areas of Poland has not changed (KUŹNIAK 1991, MATYJASIAK 1995, DIEHL 1998). However, DIEHL (1998), reported that mean clutch size increased between 1964–1990 in conditions of increasing temperatures. The increase resulted mainly from a growth in the proportion of 6 and 7 egg clutches. In contrast, MATYJASIAK (1995) did not show similar long-term trends in reproductive parameters based on data from the Polish Nest Record Scheme. LUDER (1986) analysed data from nest record cards in Switzerland and reported mean clutch size decreases from 5.32 to 5.06 eggs during the period 1901–1977. However, in the same period there were decreases in the frequency of May clutches. Moreover the mean arrival date of Red-backed Shrike in Switzerland had changed, since the birds started to arrive later. This was in contrast to other European studies on different bird species

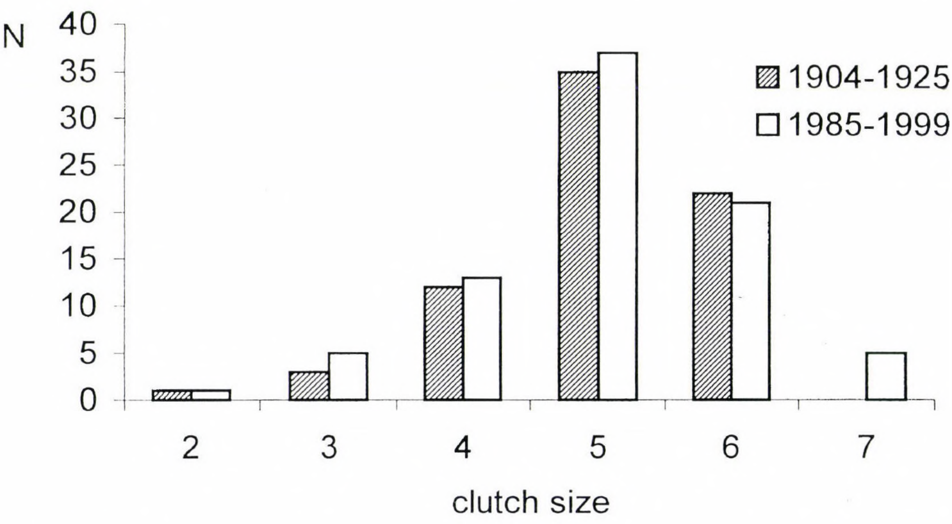


Fig. 2. Comparison of clutch size frequency between the two data sets, from museum collection (black bars) and from nest-cards (white bars). No significant differences were recorded (chi-square = 0.303, df = 5, p > 0.9)

(CRICK *et al.* 1997, CRICK & SPARKS 1999). According to JAKOBER and STAUBER (1983), arrival time and the timing of laying were strongly correlated and depended on temperature. The results of LUDER (1986) might differ from the others, because the author analysed only data up to 1977 and the impact of climate change on the environment, observed as the increase of temperature, started to occur only from the 1980s onwards.

The data presented here differed from the above results. In the two compared study periods there were no significant differences in laying date or in clutch size despite small changes in temperature in May. Between 1905–1925 the temperatures were relatively warmer compared to recent years (TREPIŃSKA 1997). The influence of this appears to be minimal.

Although the study of life-history traits is important, they are not the only factors that should be considered. For example, from the conservationist point of view, information on breeding density and data on the number of fledglings per pair are important but unfortunately neither are available from museum specimens.

*

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EIGHTEEN NEW ORIENTAL SPECIES OF POECILOSOMELLA DUDA (DIPTERA: SPHAEROCERIDAE)

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Eighteen new species of the genus *Poecilosomella* DUDA, 1920, *P. borborus* sp. n. (Philippines), *P. brevisecunda* sp. n. (Sumatra), *P. conspicua* sp. n. (Sabah), *P. curvipes* sp. n. (Taiwan), *P. formosana* sp. n. (Taiwan), *P. hayashii* sp. n. (Philippines), *P. longicalcar* sp. n. (Taiwan), *P. nigra* sp. n. (Taiwan, Sri Lanka), *P. paraciculata* sp. n. (Sumatra), *P. paracryptica* sp. n. (Sabah), *P. peniculifera* sp. n. (Sumatra), *P. pilimana* sp. n. (Sumatra), *P. pilipino* sp. n. (Philippines), *P. ronkayi* sp. n. (Taiwan), *P. sabahi* sp. n. (Sabah), *P. spinicauda* sp. n. (Philippines, Tonga, Tahiti), *P. spinipes* sp. n. (Sumatra), and *P. subpilimana* sp. n. (Sumatra) are described from the Oriental region. *P. picturata* (MALLOCH, 1913) (Philippines) and *P. ornata* (DE MEIJERE, 1908) are restituted from synonymy. A key is given for all 41 known Oriental species. With 72 original figures.

Key words: Sphaeroceridae, *Poecilosomella*, new species, taxonomy, Oriental Region

INTRODUCTION

The genus *Poecilosomella* DUDA, 1920 consists of beautiful limosinine species of Sphaeroceridae with pictured body and wings. Some species are abundant in nature, and it is seldom that a large collection of Oriental flies does not contain representatives of one or more species.

The problem with *Poecilosomella* is that only a few of the known species are readily recognisable by body characteristics at low (40 to 60x) magnification. The majority of species form groups of very closely related species, the reliable identification of which is possible based on the study of male genital parts only (at about 300× or higher magnification). The differentiating characters of the genus were summarised by PAPP (1990) in his review of the Afrotropical species, to which not much needs to be added. The long tread-like process of the distiphallus, however, is a strong synapomorphy (this process is short in some species but one must be careful with such a statement, as of course, this thin process may break during genitalia preparation). One observation, however, needs correction: the postgonites are long in a number of species. It must be stressed that the male subepandrial sclerite ("subanal plate") carries important differentiating characters. I here name the sclerotized structures above the phallobase and ventral to the cerci (connecting

ventral arms of epandrium) as subepandrial sclerite, although its origin may be more complex.

Poecilosomella is a diverse genus also in the Oriental region. DUDA (1925) described nine species, DEEMING (1964, 1969) six species, HAYASHI (1997, 2002) three species, WALKER (1860), WIEDEMANN (1824), DE MEIJERE (1908), MALLOCH (1913) and PAPP (1991*a*) one species each. In this study 18 new species are described. In a previous, partial revision of the Oriental species (PAPP 1991*a*) a large number of specimens were identified but only one new species was added. Quite by chance, I prepared the male genitalia of several individuals of the "commonest Oriental species", *P. punctipennis* (WIEDEMANN), which were true *punctipennis* specimens. Consequently, I overlooked its closely related sister-species, *P. affinis*, which was discovered by Dr T. HAYASHI years ago, but which was described most recently (HAYASHI 2002).

MATERIALS AND METHODS

This paper results from the examinations of many specimens of *Poecilosomella*, which are housed in: The Carnegie Museum of Natural History, Section of Invertebrate Zoology, Pittsburgh, PA, USA (CMNH), Diptera Collection of the Department of Zoology, Hungarian Natural History Museum, Budapest (HNHM), Muséum d'Histoire naturelle Genève (MHNG), Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (NMNH), The Royal Ontario Museum, Toronto, Canada (ROM).

In the records below, hand-written label data are given in quotation marks, whereas my annotations of label data are in square brackets.

NEW RECORDS OF ORIENTAL POECILOSOMELLA, AND ADDITIONAL NOTES ON THE PREVIOUSLY KNOWN SPECIES

Poecilosomella aciculata (DEEMING, 1969)

Material studied: SRI LANKA (Ceylon, NMNH): 10 males, 11 females (1 male, 1 female in HNHM): Bad. Dist., Kande-ela Reservoir, 6200', Kan. Dist., Thawalamtenne 2200 ft., Udawattakele Sanct. 1800 ft., Kandy, Peradeniya 2300 ft., Upper Hantane Hill, N.E. Dist., Hakgala Botanical Gardens 6000 ft., Jan, Apr, Sep to Nov; Nepal: 1 male (HNHM): Royal Chitwan National Park, Bandarjhola Island – Jungle Island Resort, 84°10' E, 27°35' N, 150 m, 1995. 10. 30. – swept on *Elephas maximus* dung, leg. L. Peregovits. India: 1 female (NMNH): Yercaud., S. India, Shevaroy Hills 4500', III. 1955, P. Susai Nathan.

Known from Nepal, India, Sri Lanka and Indonesia (W. Flores, Lombok), see PAPP (1991*a*) for male genitalia figures.

Poecilosomella albipes (DUDA, 1925)

Material studied: 1 female (ROM): PHILIPPINES, Negros, Oriental: Cuernos de Negros, 7 km W. Valencia, 29 JUN – 8 JUL 1987. DC Darling, E. Mayordo. ROM 873061 – 1° rainforest edge, 700 m, Malaise w/pans.

I described a specimen from Sri Lanka (PAPP 1991*a*: 103), which may indeed belong to this species, but I cannot re-check its identity during the present study. It is, however, even more likely, that the above specimen is conspecific with the type specimen from Mt Banahao (Luzon, Philippines). In the key below it is far from *P. nigrotibiata* (DUDA), but I think they are in a closer relationship.

Poecilosomella amputata (DUDA, 1925)

Material studied: 5 males, 2 females (ROM): INDONESIA: Sumatra, Aceh, Gunung Leuser Nat. Pk., Ketambe Res. Sta., 9–21 SEP 1989, DC Darling, ROM 893087 – 1° rainforest. Young forest, Terrace 3, closed canopy, 350 m, 3°41'N, 97°39'E, Malaise trap head. 2 males, 1 female (NMNH, 1 male in HNHM): MALAYSIA: Sabah: 1 km S. Kundasang, el. 1530 m, 6/27 Aug. 1983, G. F. Hevel & W. E. Steiner.

Formerly known only from its type locality (Taiwan), see PAPP (1991a), new to Indonesia (Sumatra) and to Malaysia (Sabah).

Poecilosomella annulitibia (DEEMING, 1969)

Material studied: 18 males, 29 females (CMNH, 5 males, 7 females in HNHM): TAIWAN: Taichung, Anmashan, 2230 m, 30 Apr–4 May 1990, A. Smetana (T32).

All the important features, including armature of mid tibia (DEEMING 1969: fig. 5) and those of the male postabdomen and genitalia, i.e. the medial projection of sternite 5 & 6, lobes of surstylus (DEEMING 1969: fig. 18) seem to fit the description of the holotype male. I have previously redescribed this species (PAPP 1991*a*: 106). Formerly known from Nepal (cf. also ROHÁČEK *et al.* 2001), so its occurrence in Taiwan significantly widens its known distribution.

Poecilosomella borboroides (WALKER, 1860) species group

Some of the most surprising findings were with the species of this group. Hitherto there was only one species known with the following conspicuous combination of features: arista with very long cilia, costal hairs rather long, second costal section much shorter than third. I discovered five species in this group, two of them originally described by DE MEIJERE (1908) and MALLOCH (1913), but later put in synonymy with the widespread *P. borboroides* (WALKER, 1860). The fourth species is from the Philippines and the fifth one was collected more recently from Taiwan. The five species can be distinguished mainly by the male genitalia but one can make two subgroups of the *P. ornata* (DE MEIJERE) and *P. borboroides* (WALKER), easily recognised by the characteristics of the setae on mid tibia.

These findings underline again the risk of weakly based proposals to synonymizations of species.

Poecilosomella borboroides (WALKER, 1860)
(Figs 1–5)

Ephydra borboroides: WALKER 1860: 171.
Holotype female (BMNH): Celebes, Makessar [now Sulawesi, Ujungpandang].

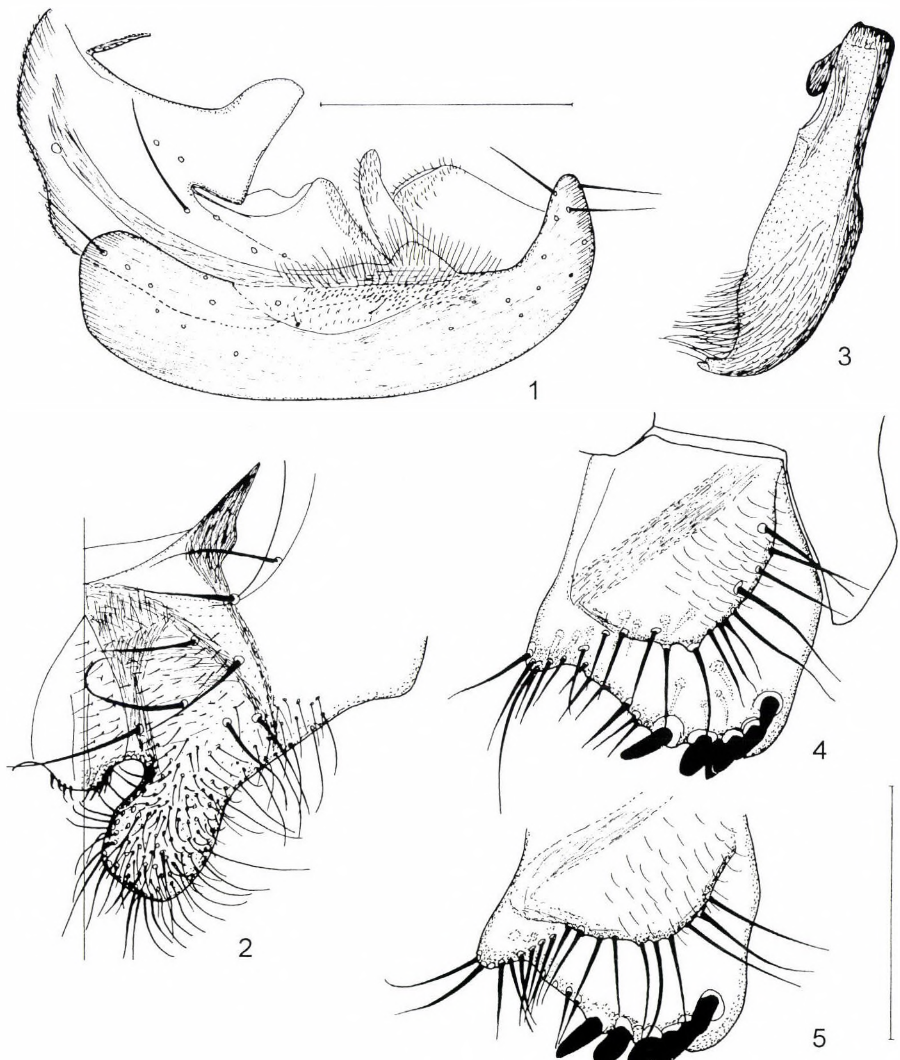
The original description says: "Length of the body 1 1/2 line; of the wings 3 lines" [that would be 7.62 mm], which must be an overstatement.

Mr NIGEL WYATT (The Natural History Museum London) examined the only type specimen and he wrote: "I have examined the holotype of *Poecilosomella borboroides* WALKER and it seems to belong to your 'species 2' [my term to differentiate the two forms I saw]. There are no ventral or anteroventral setae on the mid tibia except for the ventral seta at the apex." This piece of information is critically important in arbitration of the closely related *P. ornata*, which was formerly erroneously placed into synonymy with *P. borboroides* (see below).

Material studied: 3 males, 7 females: MALAYSIA: Sabah, G. F. Hevel & W. E. Steiner 1983 (NMNH, 1 male, 1 female in HNHM): 1 km S Kundasang, el. 1530 m, 6 Aug; Kinabalu National Park, Poring, el. 570, 8 Sept., ibid., Summit trail below Carson Camp, 1980–2700 m, 16 Sept., Telipok, 12 August. 1 male (ROM): INDONESIA, Sumatra, W. Sumatra: Kerinci-Seblat Nat. Pk., trail to L. Tujuh, 14 SEP 1989. B Hubley, DC Darling, ROM 893074 – 1° rainforest, 1640 m, screen sweep, 1°42'N, 101°19'E. 1 male, 2 females (HNHM): India, leg. Topál.

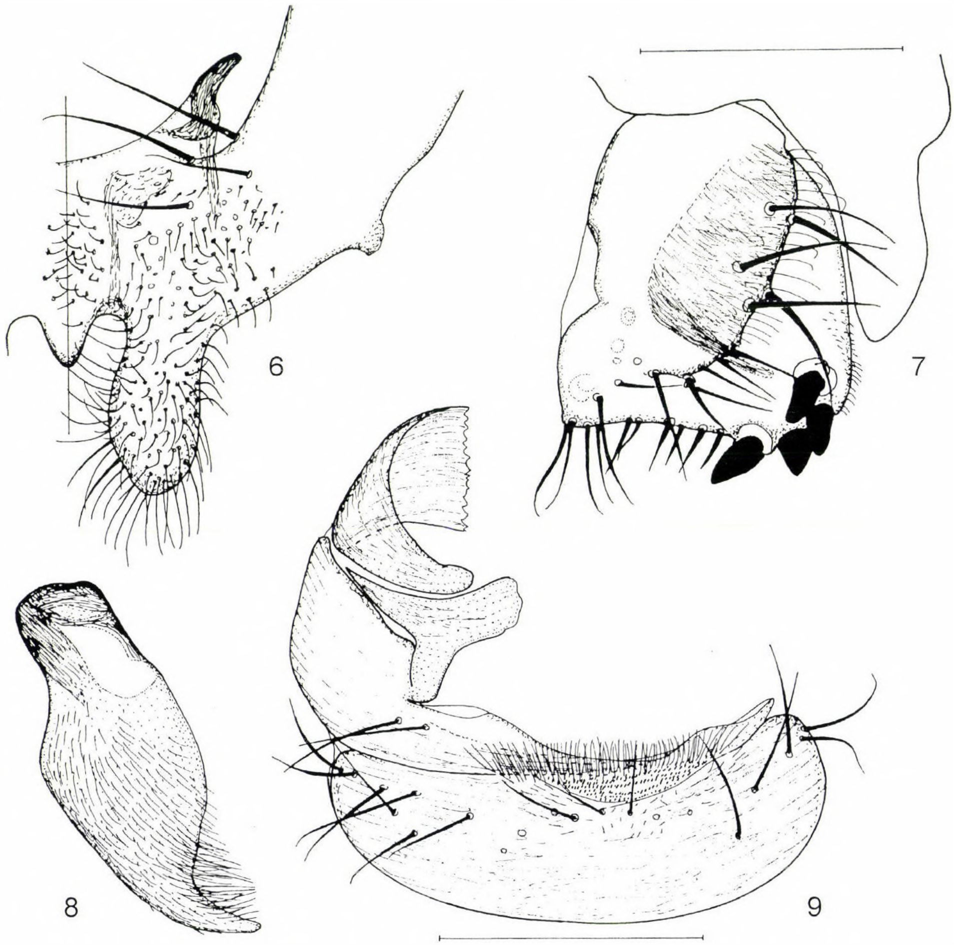
Male abdominal sternite 5 strongly asymmetrical, sternite 6 contiguous with 2 asymmetrical median lobes and a broad lobe on the left side (Fig. 1). Subepandrial sclerite (Fig. 2) with a broad

paired, apically rounded process (characteristic for this species group), whose hairlike setae are longer than in the species from the Philippines. Surstylus (Figs 4–5) apically with 6 thick black teeth (prensisetae). Postgonite (Fig. 3) less broad medially than in the Philippines form, apex more demarcated. There are slight variations in the fine details of the surstylus among specimens from different localities (Fig. 4, vs Fig. 5) but I think this normal.



Figs 1–5. *Poecilosomella borboroides* (WALKER), male postabdomen and genitalia. 1 = sternite 5 and 6, ventral view, 2 = right half of subepandrial sclerite, caudal view, 3 = postgonite, 4 = surstylus, lateral view (Sabah), 5 = apical part of surstylus (India). Scales: 0.2 mm for Fig. 1, 0.1 mm for Figs 2–5

It is useless to say that any specimens identified as *P. borboroides* before (incl. by myself before 2000) are doubtful. I hope colleagues will not regard my decision to select this biological species for the name *P. borboroides* (WALKER) just as an arbitrary decision. The form fixed by Figs 1–5 seems to be the widespread one, and I also found specimens collected rather close to its type locality (Sulawesi (Celebes) vs. Borneo, Sabah). A dissection of the female holotype of *P. borboroides* (being a female) would not get closer to a better solution.



Figs 6–9. *Poecilosomella borborus* sp. n., paratype male, postabdomen and genitalia. 6 = right half of subepandrial sclerite, caudal view, 7 = surstylus, lateral view, 8 = postgonite in widest extension, i.e. not lateral view, 9 = sternite 5 and pregenital sternites, ventral view. Scales: 0.2 mm for Fig. 9, 0.1 mm for Figs 6–8

In the last phase of work on the Oriental *Poecilosomella*, I managed to study the type of *P. picturata* (MALLOCH, 1913), described from the Philippines and formerly regarded as a junior synonym of *P. borboroides*. Based on a study of its genitalia, I would like to remove it from synonymy (see also below)

Poecilosomella ornata (DE MEIJERE, 1908), **sp. restit.** (Figs 10–13)

Limosina ornata: DE MEIJERE 1908: 177.

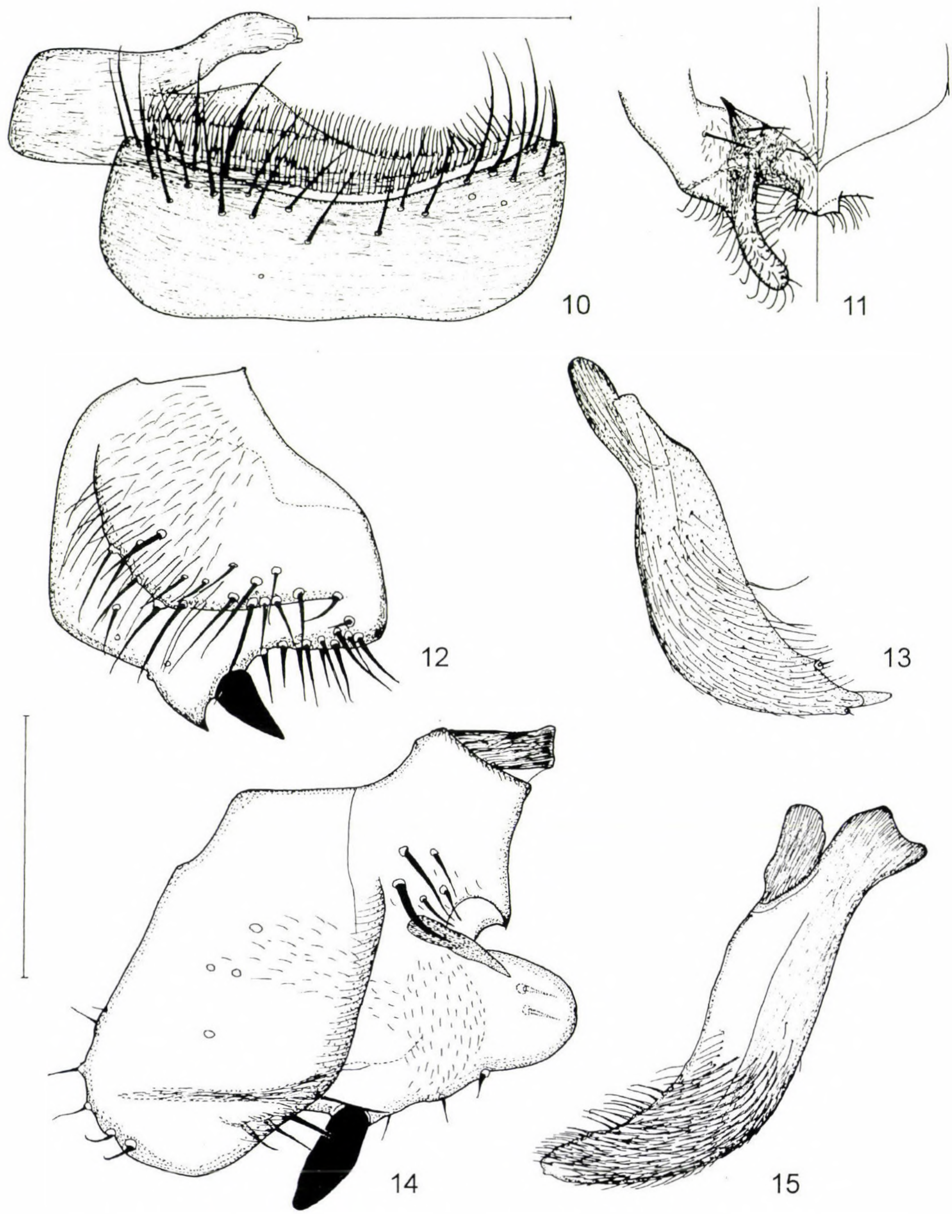
Originally two syntypes were known from Java, Semarang. It was proposed as synonymous erroneously on two different occasions for two different species (DE MEIJERE 1918, HACKMAN 1977)

Dr. HERMAN DE JONG (Amsterdam) sent me the following information: "DE MEIJERE (1918; Tijdschrift voor Entomologie 60: 323) regarded his *ornata* as a variety of *venalicia* OSTEN SACKEN. According to DE MEIJERE, both should differ in the extent of the dark coloration of the wing membrane.

The single remaining type specimen of *ornata* was placed under '*venalicia*' in our collection. It has the legs folded and closely appressed to the body. Nevertheless it is clear that the right t2 carries a strong (antero) ventral bristle near midlength. I could not find a ventro-apical bristle on either t2, although the view of both legs is quite obscured."

Material studied: 2 males (HNHM): TAIWAN: Pingtung Hsien, Kenting, Heng-Chun Trop. Botanical Garden – forest undergrowth, Oct 5, 2000, leg. L. PAPP, No. 19. 2 males, 1 female (ROM, 1 male in HNHM): INDONESIA: Sumatra, Aceh, Gunung Leuser Nat. Pk., Ketambe Res. Sta., 9–21 SEP 1989, DC Darling, ROM 893087 – 1° rainforest. Young forest, Terrace 3, closed canopy, 350 m, 3°41'N, 97°39'E, Malaise trap head; 1 female (ROM): ibid., 3–10 SEP, B Hubley, DC Darling, ROM 893027; 1 female (ROM): ibid., 7 SEP, ROM 893059 – 1° rainforest, 350 m, 3°41'N, 97°39'E. Screen sweep; 1 female: INDONESIA: E. Kalimantan, Kac. Pujungan, Kayan-Mentarang Nat. Reserve, Jun-Aug. 1993, DC Darling, Rosichon U. IIS 930596 – lowland diptero.[Dipterocarpus] forest, WWF Station, Lalut Birai, vicinity of Base Camp. Log emergence traps, 2°52'N, 115°49'E, 378 m.

Male sternite 5 (Fig. 10) less asymmetrical than in its relatives, there are 3 wide (long) rows of comparatively long hairs on the sternite 5 & 6 complex medially (Fig. 10), setae on sternite 5 long and comparatively thick. Ventral process of subepandrial sclerite (Fig. 11) long, comparatively thin, finger-like. Sursylus (Fig. 12) with only 1 thick black tooth but there is a dentate process behind it. Postgonite (Fig. 13) rather curved with definitely demarcated dentiform apex. See more in the key below.



Figs 10–15. *Poecilosomella* spp. males. 10–13 = *P. ornata* (DE MEIJERE), Taiwan: 10 = sternite 5 and 6, ventral view, 11 = left half of subepandrial sclerite, caudal view; 12 = surstylus, lateral view, 13 = postgonite, lateral view. 14–15 = *P. meijerei* (DUDA): 14 = surstylus, true lateral view, 15 = postgonite, lateral view. Scales: 0.2 mm for Figs 10–11, 0.1 mm for Figs 12–15

Poecilosomella picturata (MALLOCH, 1913)
(Figs 69–72)

Limosina picturatus: MALLOCH 1913: 653 (cf. ROHÁČEK *et al.* 2001: 201).

Holotype male (NMNH): 1) Manila PI – 2) RobtBrown Collector – 3) Type No. 15308 U.S.N.M. – 4) "Limosina picturatus MALLOCH Type" [pencil handwriting]; glued to the tip of a small long narrow card, right wing much damaged; abdomen with genitalia in a plastic microvial with glycerine.

Body features, other than mentioned below, are the same as in *P. borboroides* (WALKER) and in *P. ornata* (DE MEIJERE).

Apical part of vein R_{2+3} rather edged at curvature, distally to this point a distinct brown spot present, similarly as in *P. formosana* sp. n. Mid tibia with ventral medial seta at 3/5.

Male abdominal sternite 5 (Fig. 72) asymmetrical, median hairs located on a broad medial section, similarly as in *P. ornata*. Subepandrial sclerite (Fig. 69) unique, with comparatively broad and bare medial process and with straight and edged ventral (lateral) pair of processes, broader than in *P. ornata*; lateral processes bear thicker setae, contrary to *P. ornata* and similarly to *P. formosana*. Apical part of surstylus (Fig. 70) caudally with a single thick black tooth, whose size and position are different from those of *P. ornata*, i.e. without a process caudally to the tooth. Postgonite (Fig. 71) not very broad, not strongly narrowing apically, apical part curved apically but less strongly, apex with a small blunt projection (rather than a tooth as in *P. ornata*).

This species is distinguishable from *P. borboroides* by the distinct brown spot on its wings just distal to the curvature of R_{2+3}. Of course, the safe distinction is based on the characteristics of the male postabdomen and genitalia.

Poecilosomella cryptica L. PAPP, 1991

1 male (HNHM): TAIWAN: Pingtung Hsien, Kenting, Heng-Chun Trop. Botanical Garden – light traps, Oct 4–6, 2000, L. Peregovits & L. PAPP, No. 15. 1 male (CMNH): Taiwan: Kaohsiung, Shanping, 640 m, 21–30 April 1988. C. Young, R. Davidson, J. Rawlins.

This is a distinct species in the *P. varians* group (PAPP 1991a: figs 11–15), known only from Taiwan. It was a pleasure for me to find individuals additional to the type specimens during this project.

Poecilosomella furcata (DUDA, 1925)

1 male, 2 female (HNHM): TAIWAN: Ilan Hsien, Fu-Shan LTER Site, Sep 27, 2000 – along/over a small brook, leg. L. PAPP, No. 11.; 1 male: Taiwan, Liu-Kuei, Kaohsiung Hsien, San-Ping Forest Research Station, 700 m, Dec 30, 2001, leg L. Ronkay & A. Kun; 2 females (CMNH): Taiwan: Kaohsiung, Shanping, 640 m, 1–10 May/21–30 April 1988. R. Davidson, C. Young, J. Rawlins. 2 males, 4 females: MALAYSIA: Sabah, 1983, G. F. Hevel & W. E. Steiner (NMNH, 1 female in HNHM): 1 km S Kundasang, el. 1530 m, 6 Aug, Kinabalu National Park, Poring, el. 570 m, 8 Sept., ibid., Headquarters Area, e. 1560 m, 13. Sept.

Hitherto known from Taiwan and Viet Nam (PAPP 1991*a*), new to Malaysia.

Poecilosomella longinervis (DUDA, 1925)

Material studied: 51 males, 40 females (NMNH, 2 males, 2 females in HNHM): Nepal: Sundarijal, 4500–5000 feet, 29 October 1977, Gary F. Hevel. 2 females (ROM): Pakistan: Punjab, 3 km N. Muree, ca. 5000', 24. V. 1985, J. Lasalle, open slopes with flowers & grasses, pine forest. 1 male, 1 female (NMNH): Pakistan, Punj.[ab] Prov., Murree, 7000–7500 ft., 26–28 September 1976, G. F. Hevel & R. E: Dietz IV. 1 male (CMNH): TAIWAN: Taichung, Anmashan, 2230 m, 30 Apr–4 May 1990, A. Smetana (T32). 1 female: (NMNH): Malaysia, Sabah: 14 km W. Kundasang, el. 1450 m, 21 Aug. 1983, G. F. Hevel & W. E. Steiner.

New to Pakistan and Malaysia (Sabah).

Poecilosomella meijerei (DUDA, 1925) (Figs 14–15)

Material studied: 3 males (ROM, 1 in HNHM): INDONESIA, Sumatra, W. Sumatra: Kerinci-Seblat Nat. Pk., trial to L. Tujuh, 14 SEP 1989. B Hubley, DC Darling, ROM 893074 – 1° rainforest, 1640 m, screen sweep, 1°42'N, 101°19'E.

Gena 0.155 mm broad below eye, genal bristle 0.10 mm long. Apical section of vein R_{2+3} 0.17 mm, appendage 0.18 mm long. Scape plus pedicel are 0.155 mm, first flagellomere 0.225 mm long.

Abdominal tergite 2 with a U or V-shaped depression (as long as tergite) medially. Third tergite bears a patch of 9–10 long setae on lateral margin of the abdomen. Surstylus (Fig. 14) peculiar: anterior lobe broad and broadly rounded apically, posterior lobe continued caudally into a broad rounded process, tooth large and ventrally directed. Postgonite (Fig. 15) curved, apex rounded, apical half of postgonite covered with long pointed scales (i.e. not hairs).

The biological species (form), which I identified as *P. meijerei* (DUDA) and *P. ronkayi* sp. n. are closely related species. I have named the form, which is from a locality closer to the type locality of *P. meijerei* (DUDA), as *meijerei*. I have prepared two figures of the male genitalia in order to facilitate further findings of this

form. One of the intact males in the Royal Ontario Museum can be designated as the neotype, if the original type specimen is not found in the future (see PAPP 1991a, ROHÁČEK *et al.* 2001: 205–6).

Poecilosomella multipunctata (DUDA, 1925)

Material studied: 1 male (NMNH): MALAYSIA: Sabah: 1 km S. Kundasang, el. 1530 m, 6 Aug. 1983, G. F. Hevel & W. E. Steiner.

Widespread (see PAPP 1991*a*), new to Malaysia.

Poecilosomella nepalensis (DEEMING, 1969)

Material studied: 2 males (NMNH): NEPAL: Sundarijal, 4500–5000 feet, 29 October 1977, Gary F. Hevel. 1 male (NMNH): Pakistan, Punj.[ab] Prov., Murree, 7000–7500 ft., 26–28 September 1976, G. F. Hevel & R. E: Dietz IV.

I have added further to the original description, including with five figures of the male postabdomen and genitalia (PAPP 1991a: figs 21–25). I would like to call attention to the peculiar sclerotization of the phallus, which is also partly depicted in its original description (a thick black line behind surstylus in fig. 17 of DEEMING 1969). Formerly known from Nepal and India, new to Pakistan.

Poecilosomella pectiniterga (DEEMING, 1964) species group

DEEMING (1964) described a peculiar *Poecilosomella* species from Christmas Island, whose male tergite 5 was broadened on right side with 9–13 extremely long thick marginal setae (erroneously as "sternite 5" in PAPP's (1991a) key). This character is so impressive that it led me to assume that any and all specimens with such setae should automatically be assigned to *pectiniterga*. Nevertheless, HAYASHI (1997) described two additional new species with this character (*P. insularis* from the Biak I. and Papua New Guinea and *P. pappi* from Sri Lanka and Malaysia). Below a fourth species is described from the Philippines. All identifications (published or not), made between 1964 and 1997 must be checked.

Poecilosomella punctipennis (WIEDEMANN, 1824) species group

Much to my regret, we must regard all identifications prior to Dr. HAYASHI's discovery of *P. affinis* in 2002 as unreliable, incl. all material published by myself in 1991 (a, b) and 37 specimens, preserved in the NMNH and identified by myself in 1991. Reliably identified specimens are as follow:

P. affinis HAYASHI, 2002

Material studied: TAIWAN, leg. L. PAPP 2000 (HNHM, 67 ex.): 27 males, 35 females: Ilan Hsien, Fu-Shan LTER Site, Sep 26, 2000, leg. L. PAPP, No. 7 – lake shore vegetation and along a brook bed; 1 male: ibid., over a rocky brook, No. 6; 2 female: ibid., Sep 27, along/over a small brook, No. 11; 1 male: Pingtung Hsien, Kenting, Heng-Chun Trop. Botanical Garden – light traps, Oct 4–6, L. Peregovits & L. PAPP, No. 15; 1 male: Taipei, Nanshih Chiao, Han-Lo-Da, 450 m, along a small canal, Oct 13, No. 24. NEPAL: 37 males, 85 females (HNHM): Royal Chitwan National Park, Bandarjhola Island – Jungle Island Resort, 84°10'E, 27°35'N, 150 m, 1995. 10. 30. – swept on *Elephas maximus* dung, leg. L. Peregovits; 2 males (NMNH): Sundarijal, 4500–5000 feet, 29 October 1977, Gary F. Hevel; 1 male (NMNH): Papua New Guinea: Central P., near Kamulai, 3 Apr. 1983, 1200–1300 meters, J. W. Ismay; 1 male (NMNH): Cyclops Mts., Dutch N. G. [now Irian Jaya], 1000 ft. Jean Lafoon coll., IV–1–45. – "308".

P. punctipennis (WIEDEMANN, 1824)

Material studied: INDIA: 3 males (HNHM, see PAPP 1991b): Uttar Pradesh, Agra, Shah Jehan Gardens, 23/25 XI. 1989, leg. PAPP L. – swept on shore of small ponds and on a watered grassy area. VIET NAM: 1 male (HNHM): Topál – Matskási, 1971, No. 252. PHILIPPINES: 6 males, 1 female (NMNH, 1 male in HNHM): Leyte Island, Tacloban, Aug. 12, 1945, David G. Hall. New Caledonia: 2 males (NMNH): Aug 12 1944, Noumea, Wilfred Crabb. Tubuai Is: 4 males (NMNH): Tubuai, VI–8–10, 1965, D. Sixberry – between stone pyramid & Mataura. Tonga: 1 male (NMNH): Vavau, Neiafu, 0–100m, III–74, N.L.H. Krauss. FIJI: 7 males, 12 females (NMNH, 1 male, 1 female in HNHM): Suva Island, Oct 24, 1945, David G. Hall; 3 males (NMNH): Fiji Isls, June 15, D./L. Stoner, Vivia. 5 males (NMNH): Segond Chan.,: Esp. Santo, N. Hebrides, Jean Laffoon coll., VII–44, "143"/"135"/"127". IRIAN JAYA: 3 males (NMNH): NETH. N. GUINEA: ajoe[?], 26 Oct '45, D. G. Hall. 1 male (NMNH): FR. POLYNESIA, Opunohu, VII. 6. 1959, D. E. Puleston.

Poecilosomella rectinervis (DUDA, 1925)

Material studied: 1 male, 1 female (ROM): INDONESIA, Sumatra, W. Sumatra: Kerinci-Seblat Nat. Pk., trial to L. Tujuh, 14 SEP 1989. B Hubley, DC Darling, ROM 893074 – 1° rainforest, 1640 m, screen sweep, 1° 42'N, 101° 19'E.; 1 male, 1 female (CMNH, HNHM): TAIWAN: Nantou Hsien, Meifeng, 2130 m, 10–17 July 1993. A. Smetana, T147 – yellow pan traps; 2 males, 3 females

(CMNH, 1 female in HNHM): TAIWAN: Taichung, Anmashan, 2230m, 30 Apr–4 May 1990, A. Smetana (T32).

I redescribed this species (PAPP 1991*a*: 118) based on a study of its holotype. It was described from Java, but HACKMAN (1977) listed it also from Burma. It belongs to a difficult species group and since I have not seen specimens from Burma, I think its occurrence from only Indonesia (Java, Sumatra) and Taiwan is well based.

Poecilosomella varians (DUDA, 1925)

Material studied: 2 males, 1 female (NMNH, 1 male in HNHM): SRI LANKA: Mate. Dist., Sigiriya, 800 feet, black light, 13–14 November 1976 – Collected by: G. F. Hevel, R. E: Dietz IV, S. Karunaratne, D. W. Balasooriya; 1 male (NMNH): CEYLON, Anu. Dist., Irrigation Bungalow, Padaviya 180 ft., 27 Feb.–9 Mar. 1970, Dawis & Rowe.

This species seems widespread if we take all the former distribution data into consideration (HACKMAN 1977, PAPP 1991a,b). However, since there are a number of species which can be separated from *P. varians* only by the characteristics of their genitalia, some of the earlier records must be corroborated. It was recorded as new to Sri Lanka by PAPP (1991b), and is also reliably known from Singapore (type locality), India, Indonesia (W. Flores), cf. PAPP (1991*a*).

P. brunettii (DEEMING, 1969), *P. nigrotibiata* (DUDA, 1925) and *P. himalayensis* (DEEMING, 1969) were not found during this study. For their detailed morphology see DEEMING (1969) and PAPP (1991*a*).

DESCRIPTIONS OF THE NEW SPECIES

Poecilosomella borborus sp. n.
(Figs 6–9)

Holotype male (ROM): PHILIPPINES, Negros, Oriental: Cuernos de Negros, 7 km W. Valencia, 8–15 JUL 1987. DC Darling, E. Mayordo. ROM 873062 – 1° rainforest edge, 700 m, Malaise w/pans.

Paratypes: 1 female (ROM): same as for holotype; 1 male (HNHM): ibid., 29 JUN – 8 JUL 1987. ROM 873061.

Measurements in mm: body length 2.08 (holotype), 2.10, 1.90 (paratype male/female), wing length 2.13 (holotype), 2.15, 2.05 (paratypes), wing width 1.02 (holotype), 1.07, 0.92 (paratypes).

Body features, incl. wing and armature of mid tibia, are the same as in *P. borboroides* (WALKER, 1860).

Male abdominal sternite 5 (Fig. 9) asymmetrical, medial hairs similar as in *P. borboroides* but thick black spinules seem more evenly set. Subepandrial sclerite (Fig. 6) with longer and less broad ventral process than in *P. borboroides*. Apical part of surstylus (Fig. 7) caudally with 4 thick black teeth, whose size and position are different from those of *P. borboroides*. Postgonite (Fig. 8) very broad, strongly narrowing and curved apically but apex not definitely demarcated.

Etymology: The specific epithet of this species is *borborus*, for its very close relation to *borboroides*.

Distribution: Philippines.

This species is not distinguishable from *P. borboroides* except on the characteristics of the male postabdomen and genitalia. That is, I cannot differentiate between females. However, males are different in all four morphological parts depicted on Figs 6–9 vs 1–5, i.e. there is no doubt about their identity as different species.

Poecilosomella brevisecunda sp. n.
(Figs 16–19)

Holotype male (ROM): INDONESIA: Sumatra, Aceh, Gunung Leuser Nat. Pk., Ketambe Res. Sta., 9–21 SEP 1989, DC Darling, ROM 893087 – 1° rainforest. Young forest, Terrace 3, closed canopy, 350 m, 3° 41'N, 97° 39'E, Malaise trap head.

Paratypes: 1 male (HNHM): ibid., 3–10 SEP, B Hubley, DC Darling, ROM 893027; 1 male (ROM): ibid., 7 SEP, ROM 893059 – 1° rainforest, 350 m, 3°41'N, 97°39'E. Screen sweep; 1 female (ROM): ibid., B Hubley, DC Darling, ROM 893045 – Mature forest, Terrace 4, light gap, 400 m.

Measurements in mm: body length 1.85 (holotype), 1.55–1.80 (paratype males), 2.00 (paratype female), wing length ca. 1.87 (holotype), 1.57–1.95 (paratypes), wing width 0.86 (holotype), 0.85–0.95 (paratypes).

A single strong, posterior, 0.18 mm long orbital seta present, anterior one hair-like and hardly longer than diameter of the posterior one at base. Facial plate shiny reddish yellow. Antennae reddish, first flagellomere enlarged but less than in *P. hayashii*, 0.125 mm, scape and pedicel combined 0.103 mm long. Arista 0.05+0.50 mm long, aristal cilia 0.04 mm, cilia on flagellomere slightly shorter than 0.02 mm. Two pairs of thin and short *ifr* setae.

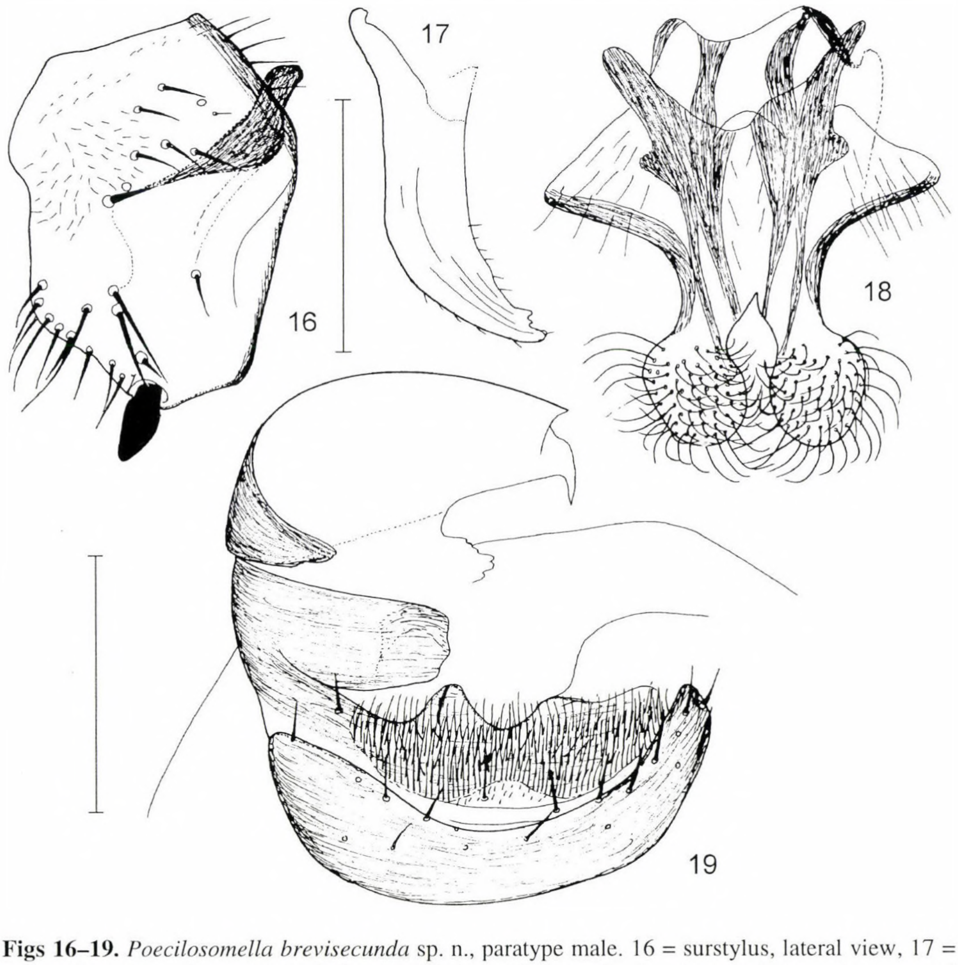
Mesonotum blackish brown, almost dull, with 4 sagittal, 4 dorsocentral and 3 lateral silvery spots. Scutellum somewhat wider than long, with 5 silvery spots.

Costal vein terminates at R_{4+5}, vein R_{2+3} meets costa perpendicularly. Second costal section about 3/5 length of third section (not precisely measurable on downcurved wings). Wings without vein appendage on R_{2+3} subapically. Second costal section much shorter than third, costa terminates at vein R_{4+5}. Wings completely dark, only cross-veins light, no light spot amidst cell r2+3, as in *hayashii*. Knob of halter dark brown, stalk yellow.

Legs dark brown, except for the following: apices of femora yellowish, all tibiae with broad medial and apical light rings. Basal 3/4 of fore basitarsus and the whole 5th tarsomere dark, other parts of fore tarsus white. Mid tarsus white at apices of basitarsus and 2nd tarsomere, as well as whole 3rd tarsomere white, other parts dark. Hind basitarsus and 2nd tarsomere enlarged and thickened but

in a less extent than in HAYASHII, only 3rd hind tarsomere white. Fore tibia thickened but less than in *P. hayashii*. Mid tibia with a strong anterior seta at 11/20, anterodorsals at 1/4 and 17/20, posterodorsals at 1/5, 9/20 and 3/4, and a strong mid ventral seta distally to the middle (at 13/20). Male mid tibia without long hairs. No true ventroapical on mid tibia, 3 small black setae instead, though the longest one longer than basitarsal diameter.

Sternite 5 slightly asymmetrical, the complex of sternite 5 & 6 (Fig. 19) with at least 3 rows of long thin hairs on a rather broad median part. Epandrium with comparatively short setae. Subepandrial sclerite (Fig. 18) peculiar with a pair of sclerotized and black melanized inner processes and with a pair of rather long, knobbed, rounded, hairy, ventral (outer) processes. Male surstylus (Fig. 16) comparatively long, anterior and posterior lobes not clearly separated but with a posterior, rather ventral tooth. Postgonite (Fig. 17) rather short, apical third strongly curved, with two small apical



Figs 16–19. *Poecilosomella brevisecunda* sp. n., paratype male. 16 = surstylus, lateral view, 17 = postgonite, 18 = subepandrial sclerite, caudal view, 19 = sternite 5 and pregenital sternites, ventral view. Scales: 0.1 mm for Figs 16–18, 0.2 mm for Fig. 19

projections over its narrowly rounded apex. Distiphallus shorter than aedeagal apodeme, without any conspicuous (melanized) sclerotization, apically upcurving.

Female terminalia not studied in detail; both epiproct and hypoproct rather short, female cerci with 2 pairs of rather straight medium long hairs, i.e. shorter than in *P. hayashii*.

Etymology: The name of this species refers to its rather short second costal section.

Distribution: Indonesia (Sumatra).

P. brevisecunda sp. n. is an easily recognisable species; it is probably closely related to *P. hayashii* sp. n. However, not only is the second costal section comparatively short, but vein R_{2+3} meets the costa perpendicularly. Anterior orbital seta reduced to a minute hair (see more in key).

Poecilosomella conspicua sp. n.

Holotype male (NMNH): MALAYSIA: Sabah: 1 km S. Kundasang, el. 1530m, 22 Aug. 1983, G. F. Hevel & W. E. Steiner.

Paratype male (HNHM): data same as for the holotype; paratype female (NMNH, abdomen much contracted): ibid., 25 km N Tambunan, el. 1500 m, 10 Aug.; 1 female (MHNG, in a vial with alcohol): [Malaysia] Sabah, Crocker Range, 1550–1650 m, 16. V. 87, leg. D. H. Burckhardt et I. Löbl, 27a. [à proximité du col (route Kota Kinabalu – Tambunan), forêt de Lithocarpus – Castanopsis; a) tamisage de bois pourri, feuilles mortés et mousses].

Measurements in mm: body length 2.98 (holotype), 2.50 (paratype male, not precisely measurable), not measurable on NMNH paratype female (c. 2.50 when alive), 2.64, wing length 2.89 (holotype), 2.47, 2.55, 2.64 (paratypes), wing width 1.36 (holotype), 1.23, 1.28, 1.24 (paratypes).

Comparatively large, robust, dark winged and dark bodied species. Body dark brown, frons, face and genae reddish, the usual frontal and thoracic spots light grey with some silvery reflection. Frontal setae and vibrissa comparatively strong, a very long (0.28–0.29 mm) upcurving genal seta present; gena below eye 0.155–0.17 mm broad. Scape plus pedicel 0.19 mm long, first flagellomere 0.21 mm. Apical wreath of bristles on pedicel comparatively long. Scape dark brown, pedicel and first flagellomere light reddish yellow, flagellomere with diffuse grey hue in its apical 2/3. Arista with long (0.05 mm) cilia. Two pairs of weak *ifr* (3 on holotype).

Anterior katepisternal half as long as posterior one. Scutellum definitely shorter than broad.

Wing covered by long microtrichia; wing margin on costa with long dense hairs (though shorter than in species of the *P. borboroides*-group). Basic colour of wings brown. Darker brown diffuse spots around H cross-vein, apical area of R_{2+3} and above the apex of Rs. Veins light brown, cross-veins plus intercrossvein section of M, apex of R_1, apex of Rs and a very short section of M opposite pale area of Rs are pale yellow or even whitish. Cells r_{4+5} and m with a darker brown diffuse spot at about their middle. Second costal section much shorter than third (0.83 mm vs. 1.16 mm, ratio 0.716). Vein R_{2+3} angulately bent to costa, with a long vein appendage (which is longer than half of the apical section of the vein). Costa ends at tip of R_{4+5}. Intercrossvein section as long as, or slightly longer than, dM-Cu. Knob of halteres and apical half of stalk dark, its basal half yellow.

Femora dark brown, only apices lighter. Tibiae also dark brown with sharply bordered pale yellow rings medially and apically, tibial bases pale coloured. Hairs on ventral part of male fore fe-

mur not particularly long but male fore tibia with hairs longer than tibial diameter ventrally, and similar hairs in its apical half also posteriorly. Fore metatarsus, as well as 2nd and 3rd tarsomeres, with extremely long hairs posteriorly. Male mid tibia ventrally with short hairs only, no mid ventral seta but a rather long ventroapical seta present. Armature of mid tibia: anterodorsals: at 12/53 small, at 18/53 long, at 43/53 very long seta and a more anterior at 32–33/53; posterodorsals: at 10/53 small, at 15/53 long, at 28/53 and 44/53 a very long seta each; longest seta 0.31 mm. Basal part of basitarsi, as well as of 2nd tarsomeres, and basal parts of 4th and 5th tarsomeres dark, apical parts and the whole 3rd tarsomere yellow.

Male genitalia are rather small. Terminalia not studied.

Female cerci short (not much longer than broad), with 2 pairs of long apical and dorsoapical hairs.

This is a rather conspicuous species; possibly only *P. furcata* (DUDA) is more or less closely related (see key).

Poecilosomella curvipes sp. n.

Holotype male (HNHM): TAIWAN: Ilan Hsien, Fu-Shan LTER Site, Sep 26, 2000 – over a rocky brook, leg. L. PAPP, No. 6.

Measurements in mm: body length 3.08 (as measurable on holotype but since abdomen downcurved and contracted, definitely longer when alive), wing length 3.15, wing width 1.29.

Body dark brown, mesonotum almost black with the usual silvery *Poecilosomella* pattern. Legs dark with the usual light rings.

Frons dark with some reddish hue, facial plate dark reddish brown. Antennae dirty red. Cephalic setae strong, 2 pairs of widely set fronto-orbitals present. Four pairs of medium long *ifr*. Genal seta only 0.21 mm long, gena below eye 0.28 mm broad. Aristal cilia rather short, 0.03 mm.

Scutellum 0.50 mm long, 0.74 mm broad, apical scutellar seta 0.71 mm. Katepisternals subequal, 0.29 and 0.33 mm.

Fore and hind femora strongly swollen, fore tibia also thickened, 0.19 mm at broadest. Male fore tibia ventrally and posteriorly, as well as all fore tarsomeres with extremely long hairs. Longest hairs on fore metatarsus 0.48 mm(!), ventrobasal hair of fore femur 0.36 mm long. Male mid tibia apically curved inwards and dorsoventrally flattened, ventrally with medium-long hairs. Male mid tibia apically without *va* seta but with a patch of short black spinules. Armature of mid tibia: anterodorsals: a short seta at 9/42, a long one at 13/42, a strong, more anterior at 25/42, the longest one at 34/42; posterodorsals: several short setae basally, long at 13/42, 2 shorter at 20 and 24/42, the longest one at 32/42.

Wings with limited patterns, pale brownish, veins yellow, brown only on the areas of brown spots. Humeral cell dark brown, costa to humeral break, humeral vein and R vein trunk to Rs dark brown, R_1 just distally to Rs and at level of R_{2-5} fork also dark brown. Costa at junction with R_1, distal section of R_{2+3} and R_{2-5} fork dark brown. A small dark spot each connecting R_1 and R_{2-5} fork and over apex of R_{2+3}. Apex of R_{4+5} is also a little darker. Second costal section comparatively very short, only 0.745 mm, third section 0.825 mm, ratio 0.90. Vein R_{2+3} without an appendage. Costa overruns R_{4+5} by a distance of its width. Medial vein strongly S-shaped.

Male tergite 5 is normal, with the usual marginal bristles. Genitalia not prepared.

Etymology: I name this species by virtue of its medially curved mid tibia.
Distribution: Taiwan.

P. curvipes sp. n. is an easily recognisable species. Among the species with normal male tergite 5 it is conspicuous by its curved mid tibia and by the extremely long hairs on fore tibia and on all fore tarsomeres. Based on its wing pattern, I cannot exclude that this is a large-bodied member of the *P. varians* species group.

Poecilosomella formosana sp. n.
(Figs 20–23)

Holotype male (HNHM): TAIWAN, Ilan Hsien, Fu-Shan LTER Site, Sep 26, 2000 – over a rocky brook, leg. L. PAPP, No. 6.

Paratypes (HNHM): TAIWAN, leg. L. PAPP, 2000: 1 male: data same as for the holotype; 1 female: ibid., lake shore vegetation and along a brook bed, No. 7; 1 male: ibid., Sep 27, along/over a small brook, No. 11; 1 female: ibid., 2 km downstream Bot. Garden, along a small river, Sep 27, No. 10; 1 male, 1 female: Taipei, Nanshih Chiao, Han-Lo-Da, 450 m, rocky forest undergrowth, Sep 23, No. 1; 2 males: Nantou Hsien, Shuili, forest undergrowth, Sep 30, No. 12.

Measurements in mm: body length 2.05 (holotype), 2.10–2.56 (paratype males), 1.80–1.86 (paratype females), wing length 2.13 (holotype), 2.15–2.45, 1.95–2.05 (paratypes), wing width 1.02 (holotype), 1.07–1.17, 0.90–0.93 (paratypes).

Body features, incl. wing and armature of mid tibia, are the same as in *P. borboroides* (WALKER, 1860). I consider the following two differences as well based: antennae blackish and wing with a diffuse dark spot distal to apex of R_{2+3}.

Male abdominal sternite 5 (Fig. 22) asymmetrical, widely emarginated medially, median hairs similar to *P. ornata*, no thick black spinules present. Subepandrial sclerite (Fig. 20) differently shaped than in *P. borboroides* or *P. ornata*, with 3 pairs of long thick setae. Surstylus (Fig. 21) with only 1 large thick black tooth, but no process behind it as in *P. ornata*. Postgonite (Fig. 23) with hairs longer than in *P. ornata*, apex rounded, no apical process but 2 minute subapical projections.

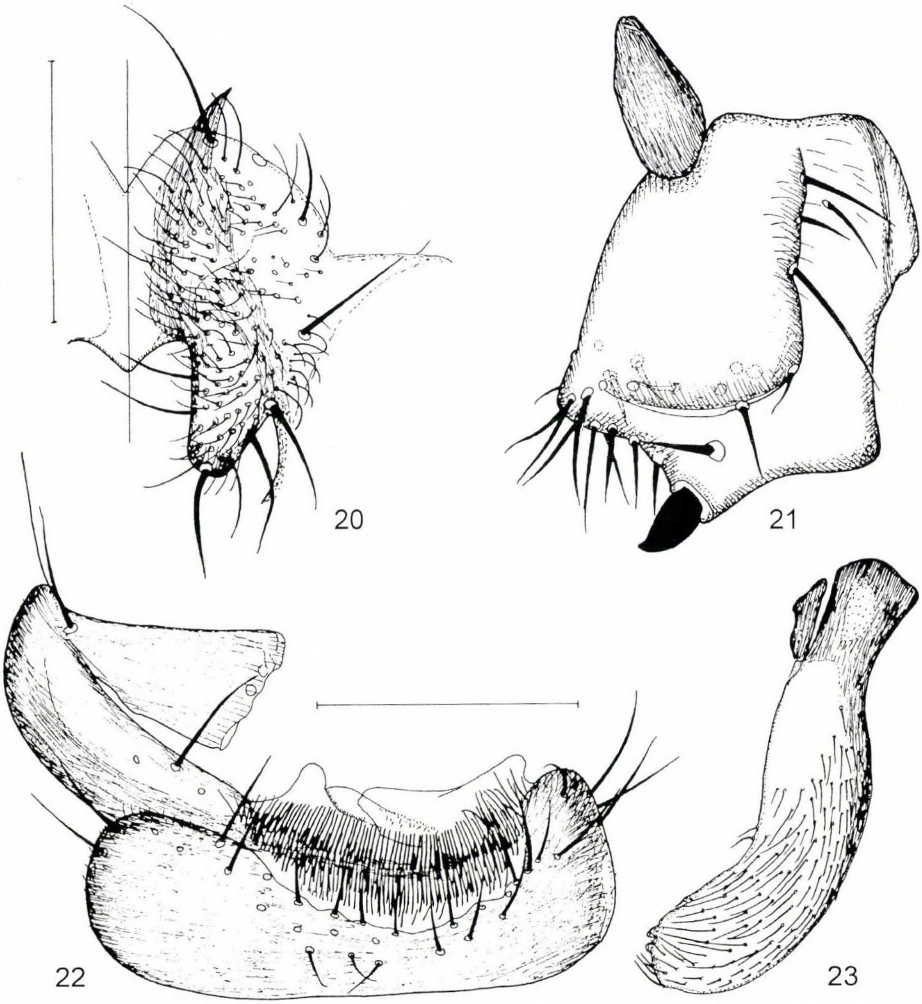
Females smaller than males, differring from females of other species in the species group as in the key below.

This species is only distinguishable from *P. borboroides* by characteristics of the male postabdomen and genitalia. I think we can differentiate between females of the two species by the two features described above. However, males are different in all the four morphological parts depicted on Figs 20–23 vs. 1–5, i.e. there is no doubt about their identity as different species.

Poecilosomella hayashii sp. n.

Holotype female (ROM): PHILIPPINES, Negros, Oriental: Cuernos de Negros, 7 km W. Valencia, 29 JUN – 8 JUL 1987. DC Darling, E. Mayordo. ROM 873061 – 1° rainforest edge, 700 m, Malaise w/pans.

Measurements: body length 2.18 mm (holotype), wing length not measurable (wing perpedicularly curved at middle), breadth 1.00 mm.



Figs 20–23. *Poecilosomella formosana* sp. n., paratype male. 20 = right half of subepandrial sclerite, caudal view, 21 = surstylus, true lateral view, 22 = sternite 5 and 6, ventral view, 23 = postgonite, lateral view. Scales: 0.2 mm for Fig. 22, 0.1 mm for Figs 20–21, 23

Body dark brown, less pictured than in the other species of the genus. Wings uniformly dark brown.

Frons dull dark brown with silvery orbitalia and interfrontal stripes, silvery dots at bases of *vti*, *vte* and a pair of silvery dots on uppermost part of occiput. Orbital setae close to each other and reduced: thin and the posterior one is only 0.28 mm long. Face bright reddish, dark brown above mouth edge. First flagellomere enlarged, 0.21 mm long, scape plus pedicel 0.155 mm long. Arista medium long, aristal cilia 0.055 mm long, cilia on flagellomere dense but much shorter. Only 2 pairs of short *ifr*. Genal bristle extremely long, 0.24 mm, ventrally placed (arising just above peristomals), gena below eye 0.14 mm broad.

Mesonotum shiny dark brown, silvery dots only at bases of the 2 pairs of strong *dc* and of the scutellar setae. Scutellum broader than long. Only 1 (posterior) katepisternal, 0.26 mm long.

Legs shiny dark brown with yellowish rings on the middle and apices of mid and hind tibia. Fore basitarsus wholly dark brown but tarsomeres 2–5 are clear white. Fore tibia thickened 0.53 mm long and 0.10 mm thick. No ventral or anteroventral setae on mid tibia, no strong ventroapical on mid tibia, 3 rather thin setae instead. Mid tarsomeres 1 and 2 dark brown, tarsomeres 3 to 5 white, shortened, their length combined less than length of mid basitarsus. Hind basitarsus and second tarsomere enlarged and extremely thickened: thickness of basitarsus is larger than that of the hind femur. Apical three tarsomeres of hind tarsus white and shortened, shorter than mid apical three tarsomeres.

Wing almost uniformly dark brown, only cross-veins and a small spot amidst cell r2+3 lighter. Costa of wing with long dense but comparatively thin fringe and without vein appendage on R_{2+3}. Second costal section only 0.465 mm, third section 0.825 mm, ratio 0.56

Female abdominal sternites rather narrow. Epiproct very small and almost quadrate. Cerci short, round with 2 pairs of long, wavy bent hairs.

Male unknown.

Etymology. I name this species in honour of Dr. Toshihiko HAYASHI, for his achievement in studies on *Poecilosomella* and other species of Sphaeroceridae.

Distribution: Known only from the Philippines.

P. hayashii sp. n. is a peculiar species. Despite the reduced pattern on its body, this is probably the most beautiful species of the known *Poecilosomella*. I think it is closely related to the *P. borboroides* species group, based on the structures of wing (long dense but thin fringe, rather short second costal section, etc.), with the similar armature of mid tibia. The coloration of body and legs make it easily identifiable.

Poecilosomella longicalcar sp. n.
(Figs 24–30)

Holotype male (CMNH): TAIWAN: Nantou Hsien, Meifeng, 2130 m, 10–17 July 1993. A. Smetana, T147 – yellow pan traps.

Paratypes: 21 males, 20 females (CMNH, 4 males, 4 females in HNHM): same as for holotype; 17 males, 10 females (CMNH, 3 males, 2 females in HNHM): TAIWAN: Taichung, Anmashan, 2230m, 30 Apr–4 May 1990, A. Smetana (T32).

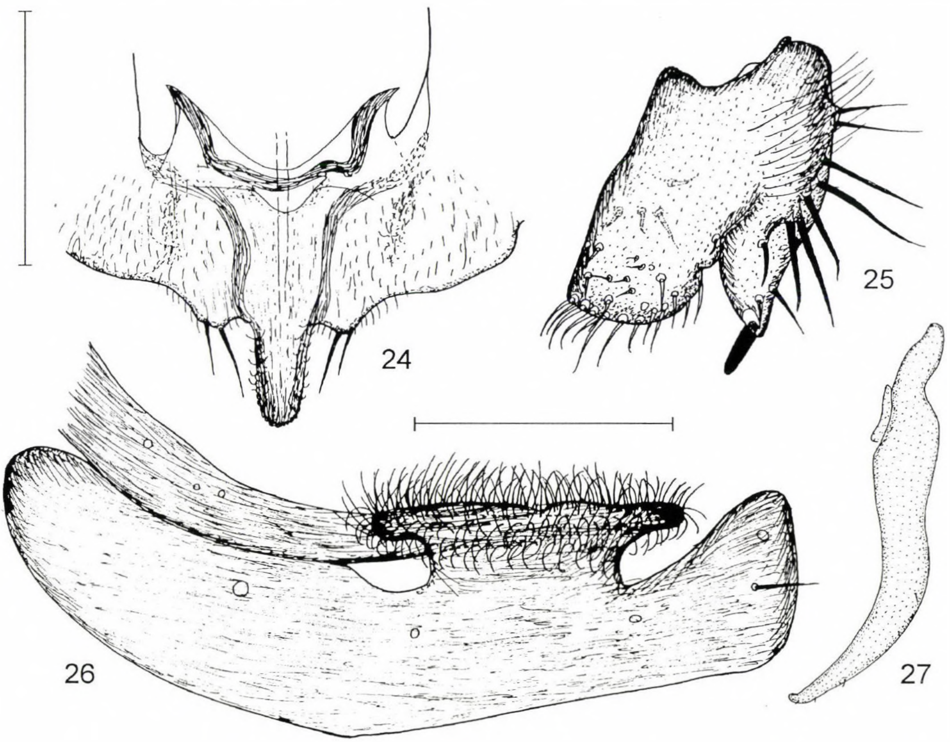
Measurements in mm: body length 3.83 (holotype, abdomen downcurved), 3.70–3.95 (paratype males), 2.64–4.00 (paratype females), wing length 3.57 (holotype), 2.98–3.88 (paratypes), wing width 1.66 (holotype), 1.54–1.72 (paratypes).

Body dark, mostly dull greyish brown,

Facial plate yellow, occiput black dusted, frons reddish except for the silvery spots. Antennae rather long, red, first flagellomere darkened apically. Arista less than twice as long as antenna, aristal cilia rather short, cilia on flagellomere not much longer. Palpi yellow. No strong genal seta. Anterior fronto-orbital much shorter and thinner than posterior one. Three pairs of *ifr*, anterior and posterior pair medium long, but median pair rather long, 0.23 mm on holotype.

Mesonotum rather dull, silvery spots tend to be confluent into silvery lines. Both dorsocentral pairs strong. Anterior katepisternal much thinner than posterior and only 1/3 to 2/5 as long. Scutellum 0.65 mm long, 0.77 mm broad, apical scutellar seta 0.95 mm (male paratype).

Wing light brown, veins ochreous but brown on the area of dark spots. Wing with vein appendage on R_{2+3}, but there are also specimens without it. Rather large and well demarcated dark brown spots around apical section of R_{2+3}, and from costa at junction with R_1 down into the discal cell, including apical part of R_1 and R_{2-5} fork. Costa overruns apex of R_{4+5} by a distance of 1.5 its width. Medial part of R_{2+3} concave, apex of R_{2+3} upcurving to costa perpendicularly, angularly, arcus usually



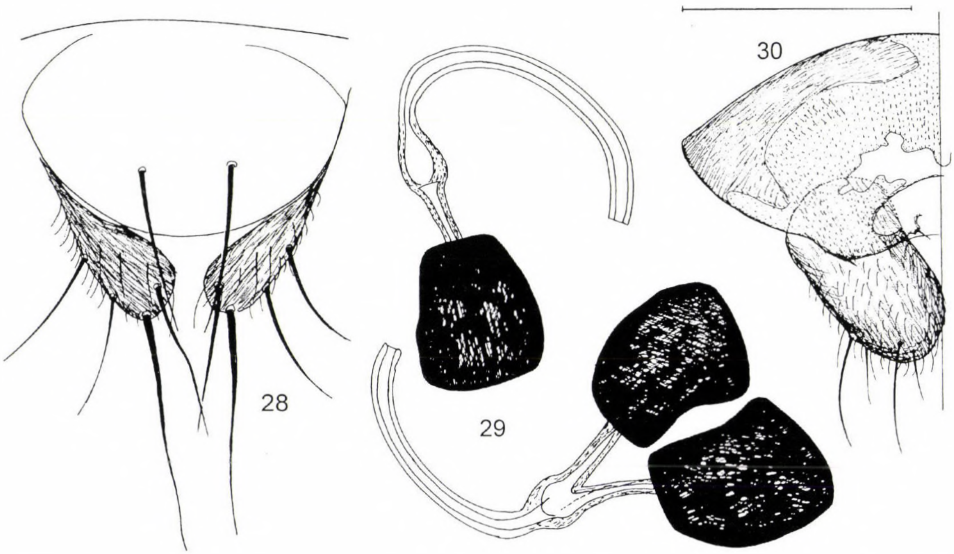
Figs 24–27. *Poecilosomella longicalcar* sp. n., paratype male, terminalia. 24 = subepandrial sclerite, caudal view, 25 = surstylus, lateral view, 26 = sternites 5 and 6, ventral view, 27 = postgonite, true lateral view. Scale: 0.2 mm for Fig. 26, 0.1 mm for Figs 24–25, 27

with a vein appendage (stump vein). Premedial part of vein R_{4+5} slightly bent towards the costa but apical half almost straight. Second costal section shorter than third section (0.90 vs. 1.125 mm on a male paratype). Cross-vein dM-Cu is much longer than intercrossvein section of M (0.27 mm vs. 0.22 mm on a paratype male).

Legs largely black, tibiae without light medial rings, bases and apices of tibiae light. Fore and hind femora much thickened. Male fore tibia ventrally and posteriorly with long hairs; hairs on fore tarsomeres somewhat longer than their own diameter. Male mid tibia in apical 3/5 ventrally with very long hairs, longest hairs 0.30 mm long: No mid ventral seta but an extremely long curved spur present, 0.25 mm on a male paratype vs. 0.49 mm long basitarsus. Apex of fore basitarsus, as well as whole 2nd and 3rd fore tarsomeres yellow, whole mid tarsomeres 1–3 yellow, apex of 2nd tarsomere and whole 3rd tarsomere of hind tarsi yellow.

Male sternite 5 strongly asymmetrical, the well sclerotized medial part of sternite 6 rather short (narrow), complex sternite 5 & 6 with a hairy, caudally broadened medial process (Fig. 26). Subepandrial sclerite (Fig. 24) sagittally with a long blunt process, which is slightly dentate around; this process is bordered by 2 pairs of setae. Otherwise subepandrial sclerite is without long setae. Male surstylus bilobed (Fig. 25), anterior lobe almost straight in profile, rounded apically, posterior lobe with a blunt ventrally directed tooth. Posterior lobe basally with a hairy ridge, which bears long setae. Postgonite (Fig. 27) rather slender, curved along a fine arcus with a few minute hairs only.

Female terminalia small, sternite 8 unsclerotized mediocaudally, there a pair of minute medioclinate setae present. Epiproct (Fig. 28) broad, undivided with a pair of medium long thin setae. Hypoproct (Fig. 30) divided; parts broadly rounded apically, with short hairs and with 2 pairs of medium long hair-like setae. Cerci small, rounded apically with 4 pairs of long or medium long thin



Figs 28–30. *Poecilosomella longicalcar* sp. n., paratype female, terminalia. 28 = epiproct and cerci, dorsal view, 29 = the three spermathecae, 30 = sternite 8 and hypoproct, ventral view. Scale: 0.1 mm for all

setae. Spermathecae (Fig. 29) black, slightly collapsed even in water, initial ducts joining spermathecae are thin, followed by a small bulbus.

Etymology: The name of this species refers to its extremely long curved ventral spur on mid tibia.

Distribution: Taiwan.

P. longicalcar sp. n. is an interesting species, whose specimens are usually with a vein appendage (stump vein) on R_{2+3} subapically, i.e. at the turning point of curvature to costa. Indeed, I think it is related to species with this character. It is distinct enough to be separated easily from all those species by the key below. However, there are specimens without vein appendage on R_{2+3}, which are to be identified carefully. The species "sp. near brunettii" of DEEMING (1969: 65) and PAPP (1991*a*: 107) might be an aberrant specimen of *P. longicalcar.*

Poecilosomella nigra sp. n.
(Figs 31–34)

Holotype male (HNHM, abdomen and genitalia in a plastic microvial): TAIWAN: Pingtung Hsien, Kenting, Heng-Chun Trop. Botanical Garden – light traps, Oct 4–6, 2000, L. Peregovits & L. PAPP, No. 15.

Paratype female (HNHM): same as for holotype; paratype male (NMNH, abdomen and genitalia in a plastic microvial): Sri Lanka: Kan. Dist., Udwattakele Sanct., Kandy, 600 meters, 12–14-X–1980 – collected in Malaise trap – K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, L. Jayawickrema, V. Gunawardane.

Measurements in mm: body length 2.50 (holotype), 2.55 (paratype male), 2.72 (paratype female), wing length 2.25 (holotype), 2.34, 2.30 (paratypes), wing width 0.98 (holotype), 0.98, 0.96 (paratypes).

Body black, including frons and antennae. Mesonotum with the usual silvery *Poecilosomella* pattern, incl. 3 rather large spot sagittally, in addition to a triangular prescutellar spot.

Facial plate brown, frons with silvery spots around setal bases. Arista medium long, aristal cilia short, at most 0.03 mm, cilia on flagellomere even shorter. Cephalic setae somewhat shorter than usual but thick, incl. 2 pairs of fronto-orbitals, their distance 0.055mm. Three pairs of short *ifr*.

Anterior dorsocental pair rather long, 0.225 mm on holotype. Two pairs of almost equally long katepisternals. Scutellum 0.41 mm long, 0.54mm broad, apical scutellars very thick, 0.56 mm.

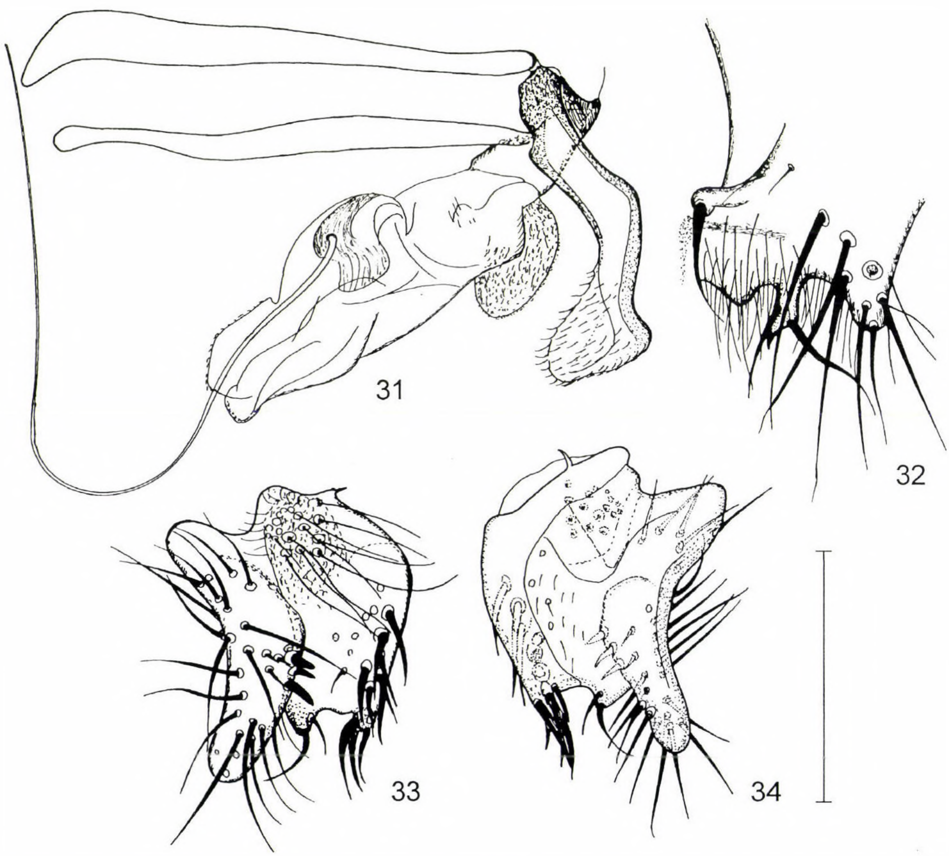
Wings clear, light yellowish grey, veins yellow but dark on the area of dark spots, dark brown spots around tips of R_1, R_{2+3} and R_{4+5} (a small spot around R_{2-5} fork continuously over R_1); also veins in basal part of wing dark brown. No vein appendage on R_{2+3}. Second costal section 0.585 mm, third section 0.56 mm, ratio 1.045. Intercrossvein section of M/dMCu 0.18/0.155 mm (paratype male).

Legs black with dirty yellow rings medially and apically. Fore and hind femora thickened, fore tibia also thicker than usual. Male fore tibia as well as fore tarsomeres 1–3 ventrally and posteriorly with long dense hairs. Armature of male mid tibia (holotype): a short anterodorsal each at 18/60 and 37/60, a very long and thick anterodorsal at 42/60; a very long and thick dorsal setae at 49/60; me-

dium long posterodorsals at 23, 28, 38/60, a longer one at 48/60. Mid tibia ventrally without a medial seta but with a distinct ventroapical. Anterodorsal and posterodorsal hair-like setae longer than usual.

Abdominal tergite 2 less melanized and probably less sclerotized on its medial third. Epandrium with the usual setae dorsally and caudally but there are numerous thick setae on ventral part. Cerci rather weakly sclerotized, without setae. Male subepandrial sclerite (Fig. 32) with a pair of acutely pointed straight processes, which bear 2 long seta. Postgonite (Fig. 31) bisinuate with broader, though partly membraneous, apical part. Male surstylus (Figs 33–34) trilobed, similar to that of *P. varians*, posterior lobe with at least 7 thick black thorns, medial lobe with 2 thick thorn-like setae, anterior lobe with numerous long hairs but also with some straight short setae (Fig. 33). Both medial part of hypandrium and phallapodeme comparatively long (Fig. 31). Distiphallus rather compact, apical threadlike process (Fig. 31) at least three times longer than distiphallus.

Female terminalia not studied. Paratype female assigned on the basis of association with holotype male.



Figs 31–34. *Poecilosomella nigra* sp. n., paratype male. 31 = genital complex with postgonite, lateral view, 32 = right half of subepandrial sclerite with apex of epandrium, 33 = surstylus, outer lateral view, 34 = surstylus, inner (medial) view. Scale: 0.2 mm for all

Distribution: Taiwan, Sri Lanka. It must be rather widespread but species in this species group are to be identified based on the characters of the male genitalia only.

P. nigra sp. n. is a member of the *P. varians* species group, so the true characteristics for its reliable identification are in the male genitalia (see Figs 31–34 and key below).

Poecilosomella paraciculata sp. n.
(Figs 35–38)

Holotype male (ROM): INDONESIA, Sumatra, W. Sumatra: Kerinci-Seblat Nat. Pk., trail to L. Tujuh, 14 SEP 1989. B Hubley, DC Darling, ROM 893074 – 1° rainforest, 1640 m, screen sweep, 1°42'N, 101°19'E.

Paratypes (ROM, 1 male, 1 female in HNHM): 2 males, 2 females: same data as holotype; 2 males, 2 females (ROM, 1 male in HNHM): Sumatra, Aceh, Gunung Leuser Nat. Pk., Ketambe Res. Sta., 9–21 SEP 1989, DC Darling, ROM 893087 – 1° rainforest. Young forest, Terrace 3, closed canopy, 350 m, 3° 41'N, 97° 39'E, Malaise trap head.

Measurements in mm: body length 1.86 (holotype), 2.00 (paratype males), 1.90–1.95 (paratype females), wing length 1.63 (holotype), 1.82–1.85 (paratypes), wing width 0.79 (holotype), 0.79–0.82 (paratypes).

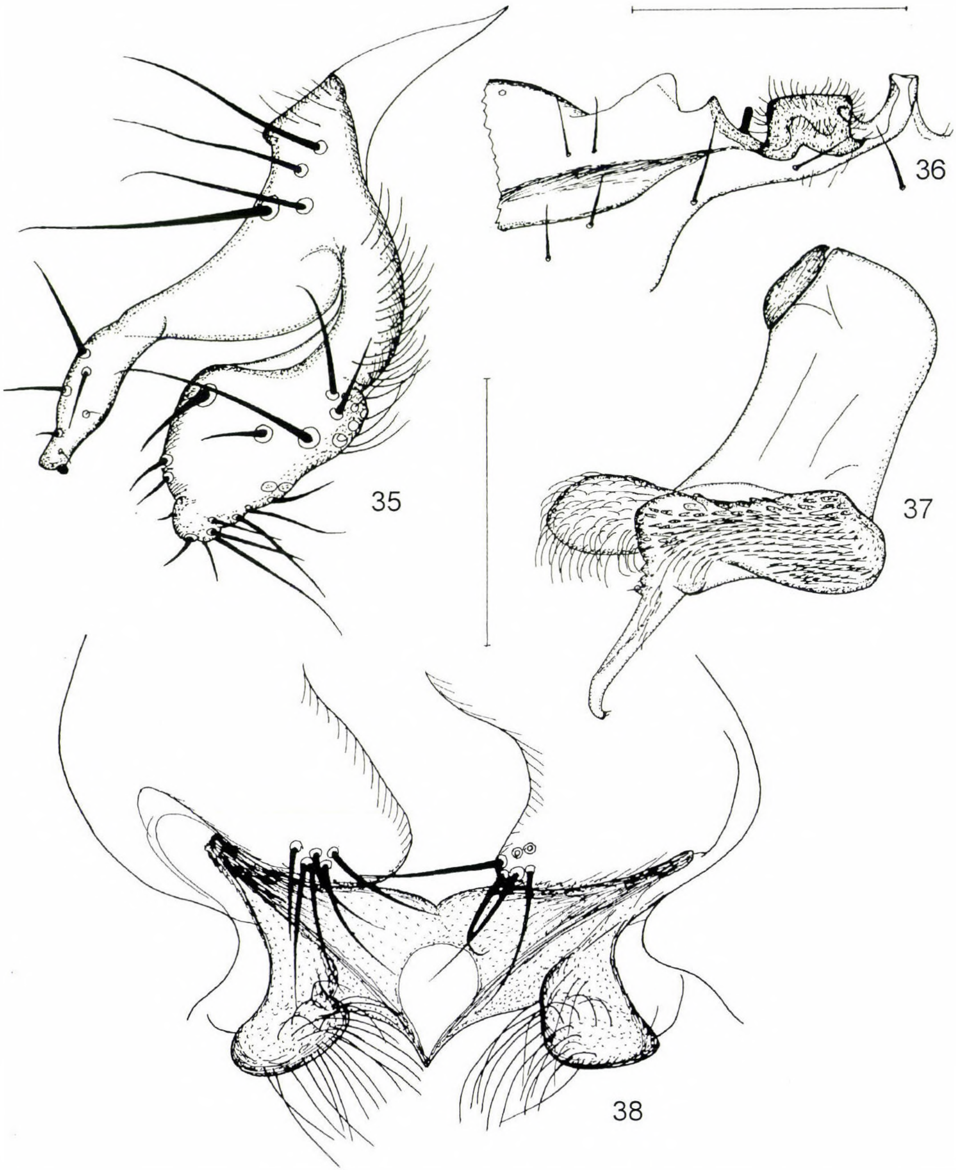
Frons reddish brown, orbitalia, interfrontal lines silvery. Facial plate reddish yellow. Two pairs of subequal orbital setae and three pairs of medium long *ifr*. Genal bristle reduced, not distinguishable from peristomal hairs. Scape lighter brown, pedicel and first flagellomere reddish, latter somewhat shorter than pedicel and scape combined (0.112 vs. 0.125 mm). Flagellomere with long (0.025 mm) cilia)

Wings without vein appendage on R_{2+3} subapically. Second costal section somewhat shorter than (subequal to) third section (on holotype 40 mm vs. 0.50 mm). A brown diffuse spot around humeral vein, between R_1 and Rs fork, around upcurving section of R_{2+3}, around apical part of R_{4+5} and a lighter brown patch from R-M cross-vein down to Cu. Costal hairs short and less dense. Costa overruns apex of R_{4+5} by a distance of the length of dM-Cu cross-vein.

Fore tarsomeres, except fore basitarsus, clear white. Legs dark brown, apices of femora light. All tibiae with broad medial and apical light rings. Male mid tibia with a short curved ventroapical spur (much shorter than tibial *diameter* subapically) but otherwise ventral hairs not long (shorter than tibial diameter). No mid ventral or anterior seta on mid tibia. Mid and hind tarsi brown with yellow apices, hind 3rd tarsomere clear yellow.

Male sternite 6 (Fig. 36) of an intricate form with a dark digitiform process medially on the left side. Sternite 5&6 complex with a separated medial quadrate hairy process. Epandrium comparatively large with medium long setae. Cerci peculiar, with a number of long and thick setae ventrally (Fig. 38). Subepandrial sclerite (Fig. 38) with a pair of characteristic ventral process which bear long hairs. Male surstylus (Fig. 35) with two long, deeply separated lobes, medial lobe long digitiform but blunt. Postgonite (Fig. 37) rather long with a long apical process, which bear short thornlets only. Anterior lobe of postgonite hairy, medial part with adpressed scales i.e. not hairs.

Female terminalia not studied.



Figs 35–38. *Poecilosomella paraciculata* sp. n., paratype male, genitalia. 35 = surstylus in widest extension, i.e. in subcaudal view, 36 = sternite 6, ventral view, 37 = postgonite, lateral view, 38 = subepandrial sclerite, caudal view. Scales: 0.2 mm for Fig. 38, 0.1 mm for Figs 35–36, 38

Distribution: Sumatra (Indonesia)

P. paraciculata sp. n. seems to be close to *P. aciculata*, though it is identifiable without any use of the male genital characters (see key below).

Poecilosomella paracryptica sp. n.
(Figs 39–41)

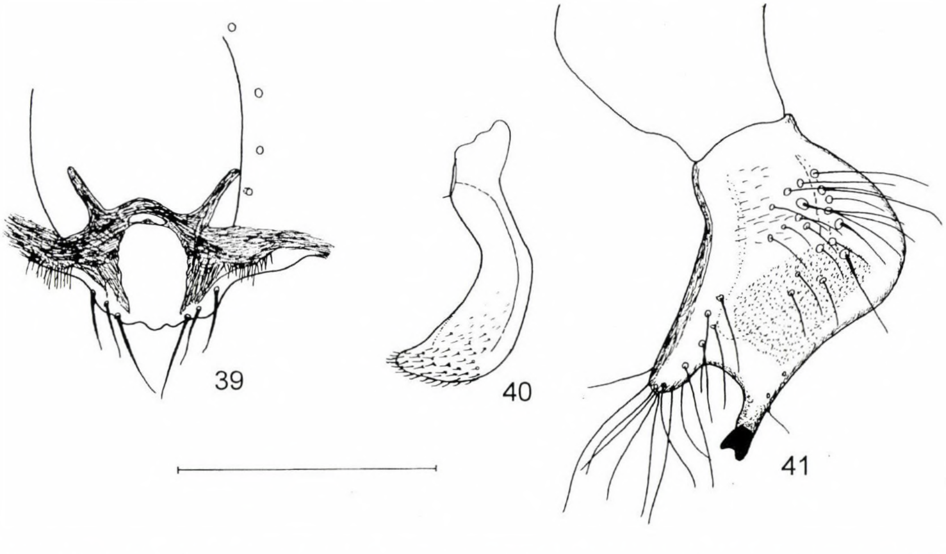
Holotype male (NMNH): MALAYSIA: Sabah, Kinabalu National Park, Headquarters Area, el. 1560m, 13 Sept. 1983, G. F. Hevel & W. E. Steiner.

Paratypes (NMNH, HNHM): 7 males, 2 females: same data as holotype (3 males in HNHM, abdomen with genitalia of one of them in a plastic microvial with glycerine); 1 male (NMNH): ibid., Poring, el. 570 m, 8 Sept. 1983.

Measurements in mm: body length 2.05 (holotype), 2.05–2.56 (paratype males), 2.05–2.18 (paratype females), wing length 2.10 (holotype), 2.05–2.41 (paratypes), wing width 1.02 (holotype), and 0.90–1.10 (paratypes).

Mesonotum, scutellum, pleurae and abdomen black, mesonotal spots silvery grey. Body characteristics largely same as in *P. varians*.

Posterior half of frons rather dark, even anterior reddish half darker than in the related species. A strong upcurving genal bristle present. Arista short, 0.465–0.48 mm, while antenna 0.28–0.29 mm, with short cilia (0.03–0.035 mm) only. Two or three pairs of short *ifr*. Proboscis large, semiglobular.



Figs 39–41. *Poecilosomella paracryptica* sp. n., paratype male, postabdomen and genitalia. 39 = subepandrial sclerite, caudal view, 40 = postgonite, lateral view, 41 = surstylus, lateral view. Scale: 0.2 mm for all

Scutellum 0.48 mm broad, 0.34 mm long, apical scutellars 0.59 mm long (holotype). Katepisternals subequal, 0.155 and 0.205 mm (holotype), 0.20 and 0.26 mm (paratype male).

No parts of fore tarsomeres white, although they are at least partly yellow. A yellow ring also on the middle of fore tibia. Male fore tibia and basitarsus (plus other two tarsomeres) ventrally to posteriorly, with long hairs (longer than their diameter at bases of hairs). Male mid tibia ventrally without long hairs, ventroapical seta more or less strong. Mid tibial armature: anterodorsals: a shorter at 13/64, long setae at 10/32 and 26/32, a very long, more anterior at 23/32; posterodorsals: a medium long at 12/40, thick and long setae at 16/40, 22/40, a very thick and even longer at 33/40.

Wings without vein appendage on R_{2+3}, dark spots as in *P. cryptica*. Apex of R_{2+3} upcurving to costa along a wide arc (i.e. not angularly bent, though it ends perpendicularly), this vein parallel with costa on a rather long medial section. Vein R_{4+5} more strongly bent towards the costa. Second costal section shorter than third section (0.52 vs. 0.645 mm on holotype). Cross-vein dM-Cu is longer than intercrossvein section of M (0.155 mm vs. 0.138 mm).

Male tergite 5 normal with the usual marginal bristles. Subepandrial sclerite (Fig. 39) without any large ventral projection but with 3 pairs of setae, sclerotization characteristic for the species. Surstylus (Fig. 41) bilobed, both lobes longer than in *P. cryptica*, posteromedial process apically with a short bidentate thorn, anterior lobe with numerous, rather long bristles. Postgonite (Fig. 40) comparatively short, broad, curved along a wide arcus, apical part with apically directed small spinules. Distiphallus with the usual apical threadlike process.

Female terminalia not studied. Paratype females assigned on the basis of association with holotype male.

Distribution: known from Sabah (Malaysia) only, but is probably more widely distributed.

P. paracryptica sp. n. is a member of the *P. varians* species group. That is, one can identify it by the male genital characteristics only, though it is easy to do so in the case of this species.

Poecilosomella peniculifera sp. n.

Holotype male (ROM): INDONESIA, Sumatra, W. Sumatra: Kerinci-Seblat Nat. Pk., trial to L. Tujuh, 14 SEP 1989. B Hubley, DC Darling, ROM 893074 – 1° rainforest, 1640 m, screen sweep, 1°42'N, 101°19'E.

Paratypes: 3 females (ROM, 1 female in HNHM): same data as holotype.

Measurements in mm: body length 1.90 (holotype), 2.12–2.20 (paratype females), wing length 1.72 (holotype), 1.90–1.95 (paratypes), wing width 0.82 (holotype), 0.85–0.88 (paratypes).

Frons dull reddish brown (except for orbitalia), facial plate shiny reddish yellow, cheeks and genae greyish red, genal seta only 0.08 mm long. Antennae reddish yellow, scape brown, first flagellomere slightly conical towards upper apex, 0.112 mm, scape and pedicel (combined) 0.125 mm. Arista with short cilia only, cilia on flagellomere about as long. Three pairs of medium long but thin *ifr* (right side on holotype 5, 4 on left on one of the paratypes).

Mesonotum blackish brown, subshiny, with 4 sagittal, 5 pairs of dorsocentral and 5 pairs of lateral silvery spots (incl. postpronotal stripes). Anterior katepisternal more than half as long as posterior seta. Scutellum slightly shorter than basal width, with 5 silvery spots, lateral basal ones rather large.

Wing normal in size, light brown, veins yellow but brown on the area of spots on wing. A brown diffuse spot around humeral vein, between R_1 and Rs fork, around upcurving section of R_{2+3}, and a lighter brown patch from R-M cross-vein down to Cu, and also an area around apical part of R_{4+5} darker than the rest of the alar plane. Costal hairs longer and denser than in its congeners, second costal section thickened (0.03 mm thick medially). Second costal section only slightly shorter than third section (0.463 vs. 0.50 mm on holotype). Vein R_{2+3} without a vein appendage subapically. Vein R_{2+3} bent along a wide arc to costa. Costa overruns apex of vein R_{4+5} by a length equalling three time its diameter, vein R_{4+5} more strongly bent towards the costa, i.e. apical part not straight, consequently medial part less curved (basal par almost straight).

Legs lighter brown. Male fore tibia strongly thickened, fore tarsus flattened. No parts of fore tarsomeres white, basal half of basitarsi and all 4th and 5th tarsomeres dark, whole 2nd and 3rd tarsomeres light yellow (on all the three legs) or proximal part of 2nd tarsomere of mid and hind tarsi dark. Apical part of femora and bases of tibiae lighter, tibiae with medial and apical broad light rings, medial rings on fore and hind tibia occupy almost 1/3 of tibia. Male fore tibia and basitarsus without long hairs, but fore basitarsus shortened with dense short hairs ventrally. Male mid tibia apically not curved inwards and not flattened dorso-ventrally, ventrally without long hairs, ventroapical seta not distinguishable, much shorter than basitarsal diameter. Male mid basitarsus with anteroventral and posteroventral rows of long black setulae. Female fore basitarsus, as well as hind 2nd tarsomere with short but very dense hairs; setulae on the ventral surface of mid basitarsus also denser than usual. Mid tibial armature (male) peculiar: no mid ventral but a strong anterior at 27/40 (short) and 3/4 (strong), anterodorsals at 1/8, 1/5 (short), 3/10 (large), and 4/5 (very large), posterodorsals at 2/5, 19/40 (thin and short), 3/4 (strong).

Male genitalia not studied. Pregenital sclerites, particularly S8 large. Epandrium normal with a pair of long dorsal setae. Cerci high, without any modification or longer hairs.

Female terminalia characteristic with dull quadrate epiproct, which bears a pair of 0.113 mm long hairs and with 2 pairs of 0.125 mm long curved hairs on cerci.

Distribution: Indonesia (Sumatra)

Etymology: The name is "brush carrier", peniculus + fero, referring to its peculiar mid basitarsus.

P. peniculifera sp. n. is an easily recognisable species by the basitarsal structures both in male and female. Its closer relationship in the genus, is at present obscure.

Poecilosomella pilimana sp. n.
(Figs 42–45)

Holotype male (ROM): INDONESIA: Sumatra, Aceh, Gunung Leuser Nat. Pk., Ketambe Res. Sta., 9–21 SEP 1989, DC Darling, ROM 893087 – 1° rainforest. Young forest, Terrace 3, closed canopy, 350 m, 3°41'N, 97°39'E, Malaise trap head.

Paratype: 1 female (HNHM): same data as for the holotype.

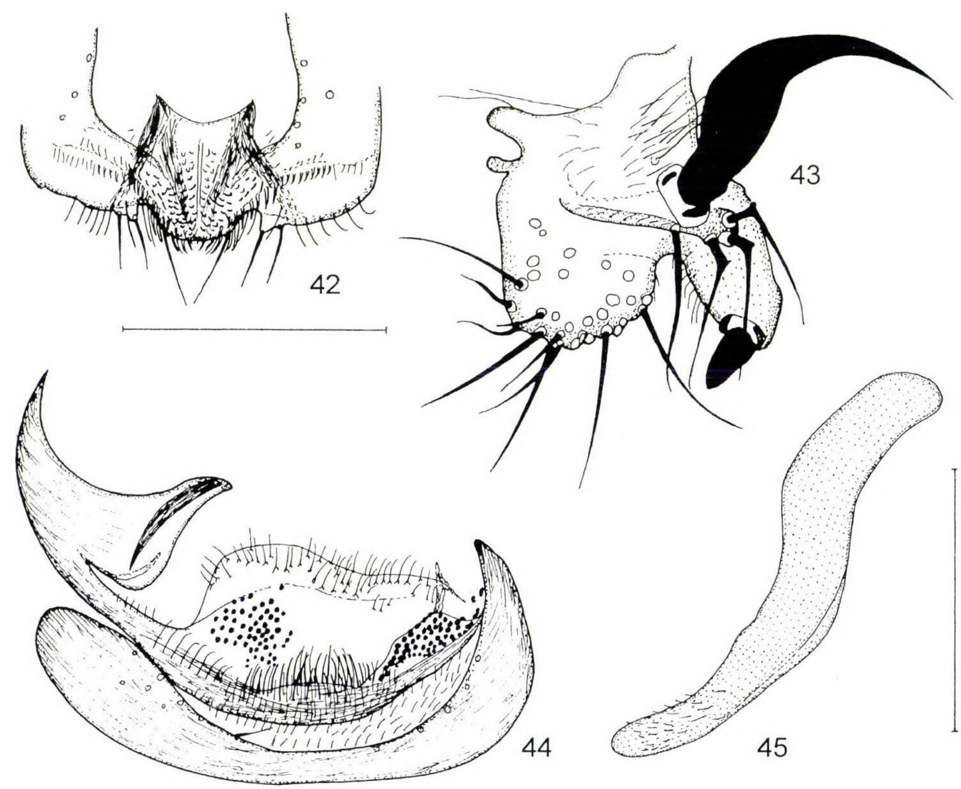
Measurements in mm: body length 2.20 (holotype), 2.51 (paratype), wing length 1.90, 1.95, wing width 0.90, 0.93.

Orbits, vertex and ocellar triangle dark, interfrontal stripe and other parts of frons red, face reddish yellow, genae dirty (greyish) yellow. Antennae yellow (pedicel and scape of paratype reddish). Longest aristal cilia 0.025 mm, cilia on apex of flagellomere slightly shorter. Two pairs of comparatively thick orbitals and two (on paratype female 3) pairs of short *ifr*. Genal seta only 0.10 mm.

Mesonotum with the usual pattern, anterior katepisternal seta longer than half length of posterior one. Scutellum basallyas wide as long.

Wings light brownish, dark brown spots at R_{2-5} fork to R_1, around apices of R_1, R_{2+3}, also a small dark spot on apex of R_{4+5}; base of wing over vein H dark brown, in cell h subbasally a light spot present. Costa just overruns vein R_{4+5}, yellow, brown on area of spots, other veins yellow. No vein appendage on R_{2+3}. Second costal section 0.463 mm, third section 0.60 mm, ratio 0.77. Intercrossvein section of M/dMCu 0.20/0.143 mm, ratio 1.40 (holotype male). Halteres waxy yellow, knob greyish yellow.

Male fore femur ventrally with long hairs, fore tibia as well as three basal tarsomeres ventrally and anteriorly with extremely long fine hairs (longest hairs on tibia 0.225mm, on basitarsus 0.22mm).



Figs 42–45. *Poecilosomella pilimana* sp. n., paratype male, postabdomen and genitalia. 42 = subepandrial sclerite, caudal view, 43 = surstylus, lateral view, 44 = sternites 5 and 6, subventral view, 45 = postgonite, lateral view. Scale: 0.2 mm for Figs 42, 44, 0.1 mm for Figs 43, 45

Armature of mid tibia: anterodorsals: at 13/40 (strong), smaller anterodorsal proximad and at 5/6 (long and thick), posterodorsals: 12, 14, 17/40, a large at 3/4 and a dorsal at 3/4, no true anterior seta. Male mid tibia with fine (i.e. not thick and stiff) hairs longer than tibial diameter ventrally, no ventroapical seta, but ventroapical part of male mid tibia with a patch of ca. 10 short black setulae.

Epandrium dorsally with 1 pair of very long setae and elsewhere with several medium long setae. Sternite 5 (Fig. 44) strongly asymmetrical, broadly emarginated medially. Emargination not sclerotized, but with fine hairs. Sternite 6 (Fig. 44) with a narrow (short) medial sclerotized part. Sagittal part of sternite 6 with longer hairs, the less sclerotized broad medial parts with flat black scales and caudally with fine hairs. Medial part of subepandrial sclerite (Fig. 42) separated, with short black pegs but with a limited number of longer setae. Surstylus (Fig. 43) bilobed, anterior lobe broad with long setae, posterior lobe more narrow but rounded apically, there with a thick black tooth. Posterior lobe laterally with an extremely long curved, posteriorly directed spine (process), whose base bordered by 3 peculiar, angularly bent setae. Postgonite (Fig. 45) S-shaped, curved, with minute hairs only, apex rounded but narrow.

Female genitalia: epiproct shiny, pentangular with almost straight caudal margin and with a pair of 0.13mm (i.e. very long) hairs. Cerci dark brown with a pair of medial (0.13mm), 1 pair of long (0.163mm) apical and 3 pairs of shorter lateral hairs.

Distribution: Indonesia (Sumatra).

Etymology: It is named on the very long hairs of male fore tibia and tarsus.

P. pilimana sp. n. is a member of the *P. punctipennis* species-group. The male of this species exhibits the longest fore tibial and tarsal hairs, ventral hairs of mid tibia are fine and definitely longer than tibial diameter. The lateral, extremely long, curved process of the male surstylus makes it easily recognisable.

Poecilosomella pilipino sp. n.
(Figs 46–49)

Holotype male (ROM): PHILIPPINES, Negros, Oriental: Cuernos de Negros, 7 km W. Valencia, 29 JUN – 8 JUL 1987. DC Darling, E. Mayordo. ROM 873061 – 1° rainforest edge, 700 m, Malaise w/pans.

Paratypes: 1 male (HNHM): same as for holotype; 1 male (ROM): ibid., 8–15 JUL 1987, ROM 873062.

Measurements in mm: body length 2.36 (holotype), 2.33 (both paratype males), wing length 2.05 (holotype), 1.95, 2.23 (paratypes), wing width 0.86 (holotype), 0.90 and not measurable (paratypes).

Mesonotum and abdominal tergites dark grey dusted.

Facial plate reddish yellow, occiput and orbitalia dark brown, most parts of frons dirty reddish, except for the silvery spots. Two closely placed fronto-orbital pairs. Antenna reddish, first flagellomere infuscated. Arista long with rather long aristal cilia. Three pairs of rather thin *ifr*.

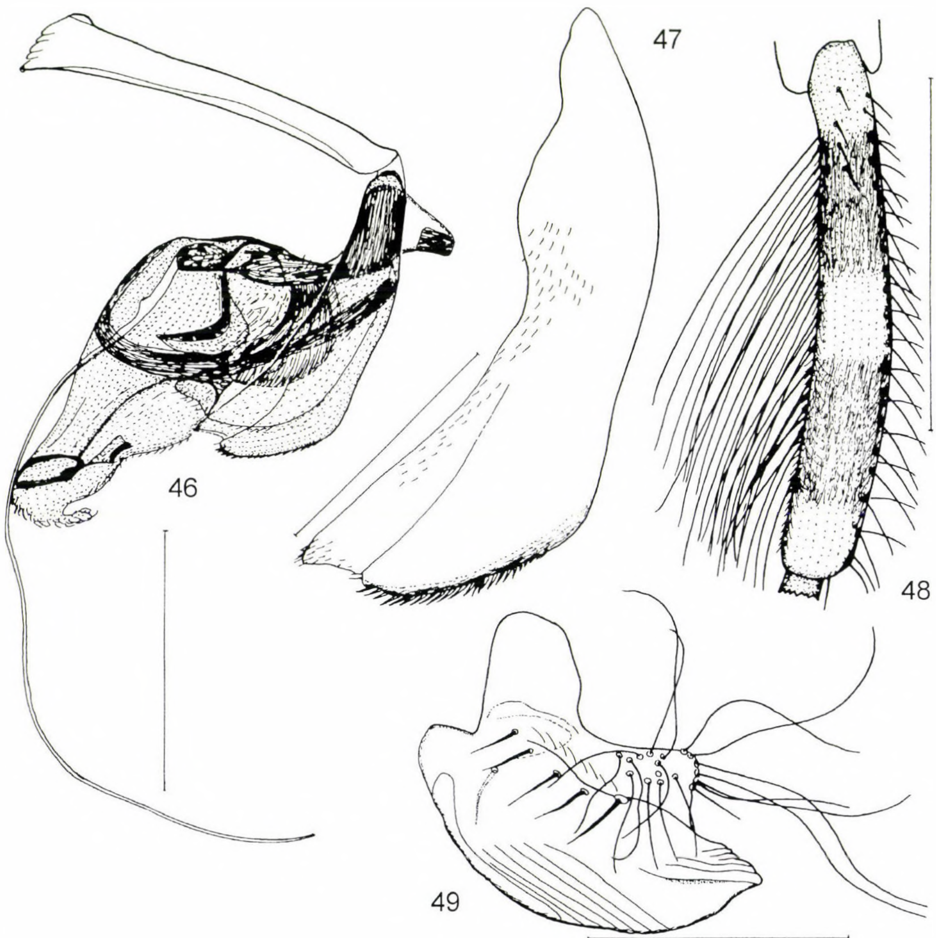
Scutellum longer than broad. Two pairs of almost equally long katepisternals.

Male fore tibia (Fig. 48) medially (ventrally) with extremely long hairs in its whole length: longest hairs on male fore tibia as long as 2/3 length of tibia. Also fore femora with long hairs ven-

trally. Fore tarsomeres dorsally with setulae longer than diameter of tarsomeres. Mid tibia ventrally with long hairs (as long as diameter of tibia), i.e. like *P. pectiniterga* (cf. HAYASHI 1997: fig. 8). No ventroapical seta on mid tibia but with 3 curved, hair-like setae instead.

Wings without vein appendage on R_{2+3}, dark spots as in *P. insularis* HAYASHI, 1997. Second and third costal sections 0.585 mm vs. 0.57 mm (holotype), ratio 1.03. Intercrossvein section of vein M 0.145 mm, dM-Cu cross-vein 0.155 mm long.

Epandrium with a limited number of rather thin setae. Cerci weakly sclerotized. Subepandrial sclerite without pecularities. Anterior lobe of surstylus with very long hairs (Fig. 49), posterior lobe larger than in *P. pectiniterga*. Postgonite (Figs 46–47) slightly bent in its basal 3/4, distal part curved



Figs 46–49. *Poecilosomella pilipino* sp. n., paratype male. 46 = genital complex with postgonite, lateral view, 47 = postgonite in higher magnification, lateral view, 48 = fore tibia, anterior view, 49 = surstylus, lateral view. Scales: 0.5 mm for Fig. 48, 0.2 mm for Figs 46, 49, 0.1 mm for Fig. 47

and broad, apical part more membraneous. Phallus rather large compared to the phallapodeme (Fig. 46). Distiphallus narrowing, apical part slightly downcurved, apical threadlike process about twice as long as phallus (Fig. 46).

Female unknown.

Distribution. Known from the Philippines only.

Etymology. The name (noun) means a male from the Philippines.

P. pilipino sp. n. is a member of the *P. pectiniterga* species group. The very long hairs along the whole length of male fore tibia are very characteristic, and the details of the male genitalia provide reliable characters for its identification. As stressed in the introductory part, all the identifications (published or not) made between 1964 and 1997 must be checked.

Poecilosomella ronkayi sp. n.

Holotype male (HNHM): TAIWAN: Ilan Hsien, Fu-Shan LTER Site, Sep 26, 2000, leg. L. PAPP, No. 7 – lake shore vegetation and along a brook bed.

Measurements in mm: body length ca. 2.31 (not precisely measurable on holotype, abdomen downcurved, ca. 2.50 mm when alive), wing length 2.46, wing width 1.10.

Scape plus pedicel 0.155 mm, first flagellomere 0.21 mm long. Genal bristle 0.12 mm long, gena below eye 0.17 mm broad. Genal bristle weak, shorter than genal diameter below eye.

Scutellum 0.46 mm long, 0.53 mm broad, apical scutellar seta 0.67 mm. Posterior katepisternal seta 0.22 mm long, anterior one only 0.085 mm.

Wing evenly brown, without diffuse brown spots in middle of the r_{4+5} radial and medial cells. Second costal section much shorter than third: 0.535 mm, third section 0.895 mm, ratio 0.60. Vein R_{2+3} with a distinct vein appendage (stump vein) subapically, i.e. at the turning point of curvature to costa. Apical part of vein R_{2+3} 0.155 mm, appendage 0.12 mm long. Intercrossvein section of M/ cross-vein dM-Cu 0.19mm/0.16mm, ratio 1.19.

Male fore tibia and basal tarsomeres without long dense hairs. Male mid tibia and basitarsus without long cilia. No mid ventral seta on mid tibia. Mid tibia with a distinct ventroapical seta, which is much longer than diameter of tibia subapically.

Distribution: hitherto known only from Taiwan.

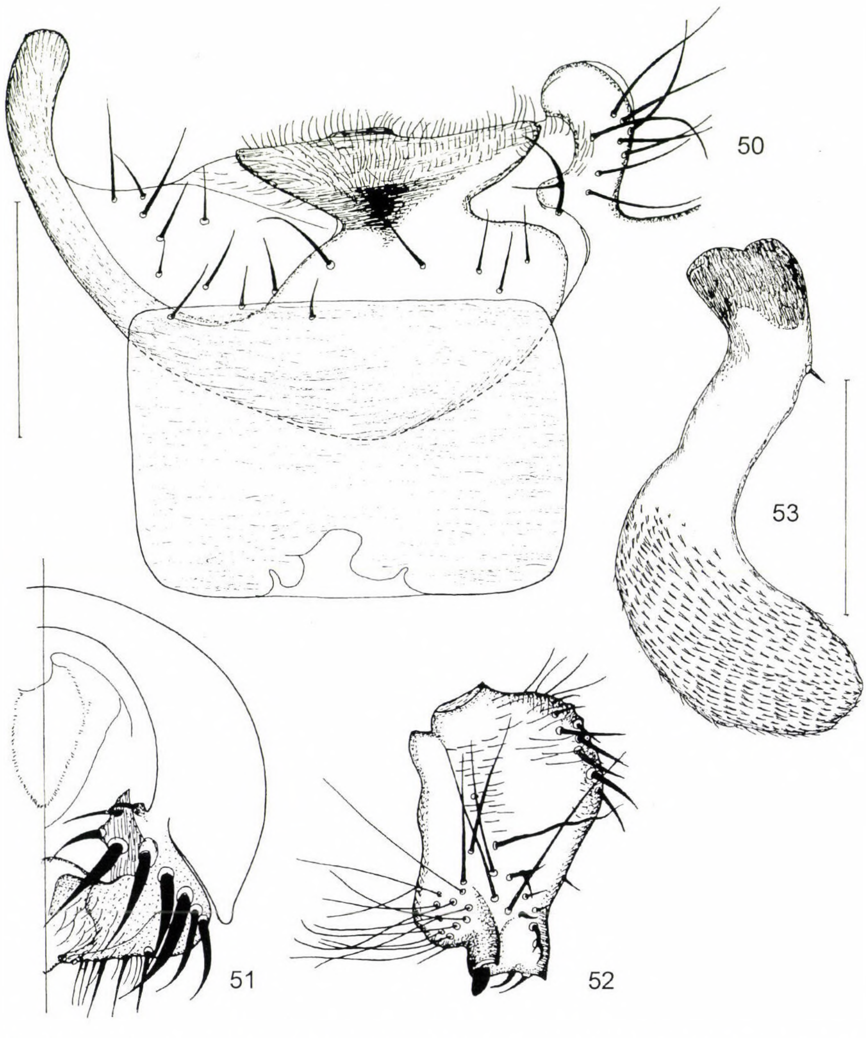
Etymology. I name this new species in honour of my dear colleague, Dr. László Ronkay (Lepidoptera Collection, Department of Zoology, HNHM), for his mental and material support, and for sharing his collections in Taiwan in 2000.

P. ronkayi sp. n. is the sister-species of *P. meijerei* (DUDA, 1925); see remarks under *P. meijerei* above.

Poecilosomella sabahi sp. n.
(Figs 50–53)

Holotype male (NMNH): MALAYSIA: Sabah, Kinabalu National Park, Poring, el. 570m, 8 Sept. 1983, G. F. Hevel & W. E. Steiner.

Paratype male (HNHM): same as for the holotype (damaged, wings wrinkled, right tarsomeres 2–5 of mid and hind tarsi lost; abdomen with genitalia in a plastic microvial with glycerine).



Figs 50–53. *Poecilosomella sabahi* sp. n., paratype male, postabdomen and genitalia. 50 = sternites 5 and 6, ventral view (S5 setae omitted), 51 = right half of subepandrial sclerite, caudal view, 52 = surstylus, lateral view, 53 = postgonite, lateral view. Scales: 0.2 mm for Figs 50–52, 0.1 mm for Fig. 53

Measurements in mm: body length ca. 2.55 (holotype, abdomen downcurved, i.e. not precisely measurable), 2.55 (paratype), wing length 2.18 (holotype), ca. 2.05 (paratype), wing width 1.00 (holotype), ca. 0.90 (paratype).

Orbits and ocellar triangle dark, interfrontal stripe silvery, other parts of frons red, face reddish yellow, genae dirty (greyish) yellow. Aristal cilia are 0.035 mm, cilia on apex of flagellomere as long. Three pairs of very short *ifr*. Genal bristle almost as long as first flagellomere.

Male fore tibia as well as three basal tarsomeres with long fine hairs (definitely longer than tibial/tarsal diameter at bases). Armature of mid tibia: anterodorsals: very strong and long seta at 11/32 and 21/34 each, shorter at 8/34 and 18/34; a very long dorsal at 27/34; posterodorsals: a very small at 5/34, a small at 13/34 and at 19/34, a long seta at 26/34; no true anterior seta. Mid tibia ventroapically without a distinct seta, but with rather long, fine hairs. Scutellum distinctly wider than long.

Wings light brownish, dark brown spots at R_{2-5} fork, at apices of R_1, R_{2+3}, and a small dark spot on apex of R_{4+5}; base of wing over vein H dark brown. Costa brown, other veins yellow. No vein appendage on R_{2+3}. Second costal section 0.55 mm, third section 0.59 mm, ratio 0.94. Intercrossvein section of M/dMCu 0.20/0.15 mm, ratio 1.33 (holotype male). Halteres mostly dark, basal half of stalk dirty yellow.

Sternite 5 normal, sternite 6 with a membraneous lobe on the left side, medially with a reverse trapezoid, hairy process (Fig. 50). Subepandrial sclerite (Fig. 51) unique with 6–7 extremely thick black, ventrally directed thorns. Male surstylus (Fig. 52) peculiar, apical lobes extremely short, medial one with a comparatively short tooth; anterior lobe with numerous very long setae; basal (caudal) part of surstylus with thick thorn-like setae. Postgonite (Fig. 53) not strongly sclerotized, peculiarly strongly curved and very broad at the same time, apical half with short but not thin, adpressed scales (rather than hairs).

Female unknown, or rather, cannot be segregated from females of other species from the material available. Indeed, I have not found characteristics to identify females of these closely related species.

Distribution: North Borneo (Malaysia, Sabah).

P. sabahi sp. n. is a peculiar species, actually distinctly different from all the species in *P. varians* species-group, by a number of characteristics in male genitalia (also, see key).

Poecilosomella spinicauda sp. n.
(Figs 54–57)

Holotype male (ROM): PHILIPPINES, Negros, Oriental: Cuernos de Negros, 7 km W. Valencia, 29 JUN – 8 JUL 1987. DC Darling, E. Mayordo. ROM 873061 – 1° rainforest edge, 700 m, Malaise w/pans.

Paratypes: 1 male, 6 females (1 male, 2 females in HNHM): same as for holotype; 1 male, 2 females (ROM, 1 female HNHM): ibid., 15–21 JUL 1987, ROM 873063 – 09° 17'N x 123° 15'E; 1 male, 1 female (ROM): ibid., 700 m, 5–13 MAY 1988, ROM 873102, DC Darling – Malaise w/pans, 1° forest edge; 1 male, 2 females (NMNH, HNHM): TONGA: Vavau, Neiafu, 0–100 m., III–74, N.L.H. Krauss; 1 male (NMNH): "Society Is., Tahiti, Paea, Robinson's Place, K.M. 26, March 27, 1261".

Measurements in mm: body length 1.80 (holotype), 1.80–2.12 (paratype males), 1.84–2.20 (paratype females), wing length 1.72 (holotype), 1.72 – 2.13 (paratypes), wing width 0.89 (holotype), 0.88 – 1.07 (paratypes).

Facial plate more convex. At least face or frons reddish or even lighter. Two pairs of long and thick orbital setae. Apical part of first flagellomere markedly lighter than rest of flagellomere, also in females. Arista rather short, only 0.55 mm on holotype. Arista with medium long cilia only (ca. 0.022mm), cilia on flagellomere shorter. Two or three pairs of medium long *ifr*. Genal seta rather long, 0.17mm on holotype.

Scutellum normal, i.e. slightly shorter than broad: 0.41 mm long, 0.60 mm broad basally, apical scutellar 0.67 mm (Tahiti paratype male). Katepisternals both large, subequal in size.

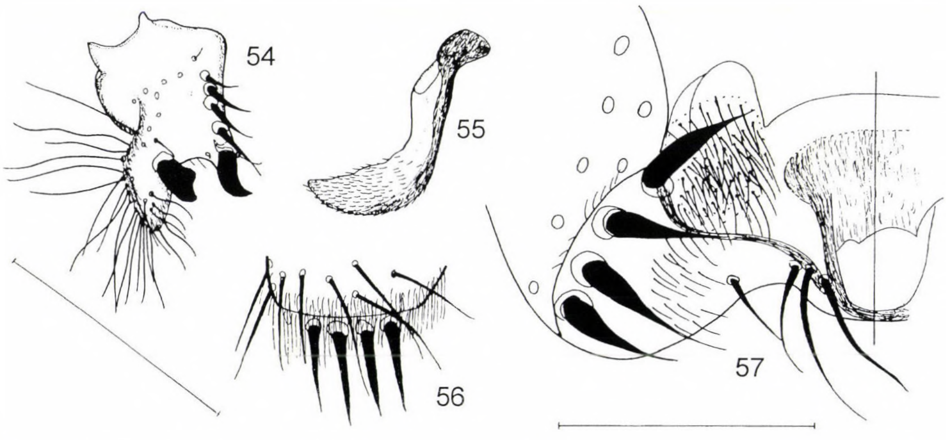
Wings broad, only about twice longer than wide, without vein appendage on R_{2+3}. Costal hairs shorter. Second costal section 0.55 mm, third section 0.57 mm (Tahiti paratype). Vein R_{4+5} more strongly bent towards the costa, i.e. apical part not straight, consequently medial part less curved (basal half slightly S-shaped).

Male fore tibia and basitarsus (possibly other tarsomeres) posteriorly, or ventrally to posteriorly, with long hairs (longer than their diameter at bases of hairs). Male mid tibia not curved inwards and not flattened. Male mid tibia ventrally without long hairs, ventroapical seta more or less strong. Fore tarsomeres at least partly yellow, but not white. A yellow ring present on the middle of fore tibia.

Male tergite 5 normal, with the usual marginal bristles. Epandrium with long setae. Lateral part of subepandrial sclerite (Figs 56–57) with 4 pairs of thick black slightly inclinate setae, more medially a patch of medially directed, thicker, almost straight, hairs. Surstylus (Fig. 54) medially with a thick but acute thorn and several strong setae, lateral lobe rather broad, its medial base with a large black dentiform (slightly bidentate) thorn (process). Postgonite (Fig. 55) comparatively short, strongly curved, rather broad medially, apical half bears dense short hairs.

Female terminalia not studied.

Distribution: Philippines, Tonga, Tahiti; probably widespread in the Pacific Oceanian region.



Figs 54–57. *Poecilosomella spinicauda* sp. n., paratype male, genitalia. 54 = surstylus, outer widest (subcaudal) view, 55 = postgonite, lateral view, 56 = ventral part of epandrium, lateral view (as if thorns on subepandrial sclerite were on epandrium), 57 = left half of subepandrial sclerite, subventral view. Scales: 0.2 mm for Figs 54–56, 0.1 mm for Fig. 57

The relationships of *P. spinicauda* sp. n. are unclear to me at present. It is possible that it is not far from the *P. varians* species group. The thick setae of subepandrial sclerite do not seem to be homologous with those of *P. sabahi*. For instance, their bases are so close to epandrium (Fig. 56) that in some views the thick setae seem to emerge from the apex of the epandrium itself. Apical part of first flagellomere markedly lighter than rest of flagellomere, in both males and females, and this character can be used to reliably identify females of this species.

Poecilosomella spinipes sp. n.
(Figs 58–64)

Holotype male (ROM): INDONESIA: Sumatra, Aceh, Gunung Leuser Nat. Pk., Ketambe Res. Sta., 9–21 SEP 1989, DC Darling, ROM 893087 – 1° rainforest. Young forest, Terrace 3, closed canopy, 350 m, 3° 41'N, 97° 39'E, Malaise trap head.

Paratypes: 4 males, 3 females (ROM, 2 males, 1 female in HNHM): same data as for the holotype.

Measurements in mm: body length 1.95 (holotype), 1.65–1.90 (paratype males), 1.85–2.24 (paratype females), wing length 1.55 (holotype), 1.25–1.95 (paratypes), wing width 0.76 (holotype), 0.66–1.00 (paratypes).

Frons dull red (except for orbitalia), facial plate shiny yellow, cheeks and genae greyish red, genal seta only 0.08 mm long. Antennae reddish yellow, first flagellomere slightly conical towards upper apex, 0.10 mm, scape and pedicel (combined) 0.112 mm. Arista with short cilia only, cilia on flagellomere about as long. Two pairs of medium long but thin *ifr*.

Mesonotum blackish brown, subshiny, with 4 sagittal, 5 pairs of dorsocentral and 5 pairs of lateral silvery spots (incl. postpronotal stripes). Scutellum slightly shorter than basal width, with 5 silvery spots, lateral basal ones rather large.

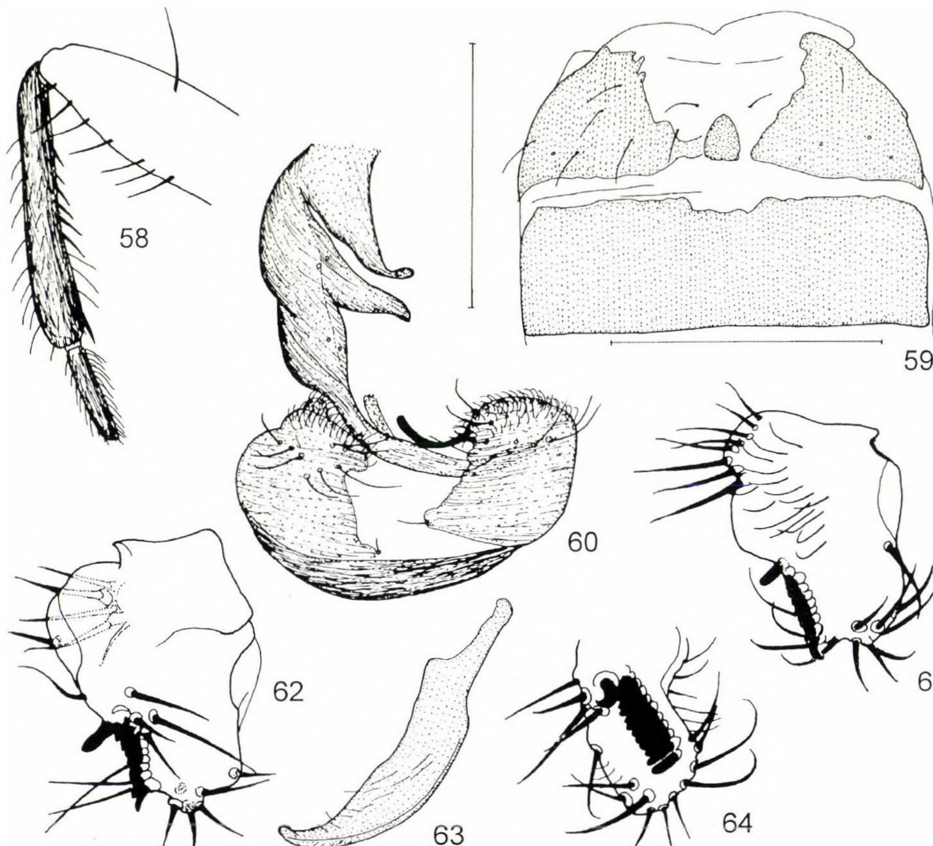
Wing rather short, light brown, veins yellow but brown on the area of spots on wing. A brown diffuse spot around humeral vein, between R_1 and Rs fork, around upcurving section of R_{2+3}, and a lighter brown patch from R-M cross-vein down to Cu. Costal hairs short and less dense. Second costal section shorter than third section (0.275 vs. 0.375 mm on one male paratype). Vein R_{2+3} without a vein appendage subapically. Vein R_{4+5} more strongly bent towards the costa, i.e. apical part not straight, consequently medial part less curved (basal half slightly S-shaped).

Legs lighter brown. No parts of fore tarsomeres white, basal half of basitarsi and 2nd tarsomeres and all 4th tarsomeres dark, apical halves and whole 3rd tarsomere light yellow (on all the three legs). Apical part of femora lighter, tibiae with medial and apical broad light rings. Male mid tibia apically not curved inwards and not flattened dorso-ventrally, ventrally without long hairs, ventroapical seta rather short, shorter than basitarsal diameter. Male fore tibia and basitarsus without long hairs, but fore tibia with a row of thick medium-long black spines ventrally (Fig. 58). Female mid tibia with two short ventroapicals, which are much shorter than tibial diameter subapically. Mid tibial armature: anterodorsals at 3/10, 7/15, 7/10, and 9/10 (all medium long), posterodorsals at 2/15 (short), 8/15, 5/6 (very strong).

Abdominal tergite 2 (Fig. 59) desclerotized medially but a small sclerotized plate present in the sagittal line. Male tergite 5 (Fig. 60) membraneous medially, with finely sclerotized hairy lobe

laterally. Sternite 6 with a fine lath medially (black on Fig. 60); in all, medial complex of sternite 5 & 6 rather simple. Epandrium short, rather small, with medium long setae. Subepandrial sclerite sagittally longer than submedially (i.e. with a small sagittal process), laterally with a hairy spot each. Male surstylus (Fig. 61) blunt, not separated into lobes, basally with a number of caudal setae, posteromedially with the usual blunt tooth, but posteral apical part with a pecten of 11 prensisetae (Figs 62, 64). Postgonite (Fig. 63) of medium width, with a couple of fine hairs only (those mainly on medial surface), its apical 1/5 curved, apex blunt.

Female terminalia characteristic with shiny epiproct, and with 2 pairs of 0.20 mm long downcurved hairs on cerci.



Figs 58–64. *Poecilosomella spinipes* sp. n., paratype male. 58 = fore tibia with basitarsus, lateral view, 59 = basal abdominal tergites, dorsal view, 60 = sternite 5 (medially torn asunder) with pregenital sternites (moved with the right half of S5), ventral view, 61 = surstylus, lateral (outer) view, 62 = same, inner view, 63 = postgonite, lateral view, 64 = apex of surstylus in dorsal view of pecten. Scales: 0.4 mm for Fig. 59, 0.2 mm for Fig. 60, 0.1 mm for Figs 61–64 (for Fig. 58 same as for Fig. 48)

Etymology: It is named on the ventral row of black spines on male fore tibia.
Distribution: Indonesia (Sumatra).

P. spinipes sp. n. is an easily recognisable species. The ventral row of thick, medium long black spines on male fore tibia seems unique among the species of the genus. Also the male genitalia show characteristic features in separating it from the other species of the *P. varians-nigra* species group. The two pairs of very long female cercal hairs are also very characteristic.

Poecilosomella subpilimana sp. n.
(Figs 65–68)

Holotype male (ROM): INDONESIA, Sumatra, W. Sumatra: Kerinci-Seblat Nat. Pk., trial to L. Tujuh, 14 SEP 1989. B Hubley, DC Darling, ROM 893074 – 1° rainforest, 1640 m, screen sweep, 1°42'N, 101°19'E.

Paratype male (HNHM): same data as for the holotype.

Measurements in mm: body length 2.65 (holotype), 2.45 (paratype male), wing length 2.48 (holotype), 2.42 (paratype), wing width 1.24 (holotype), and 1.16 (paratype).

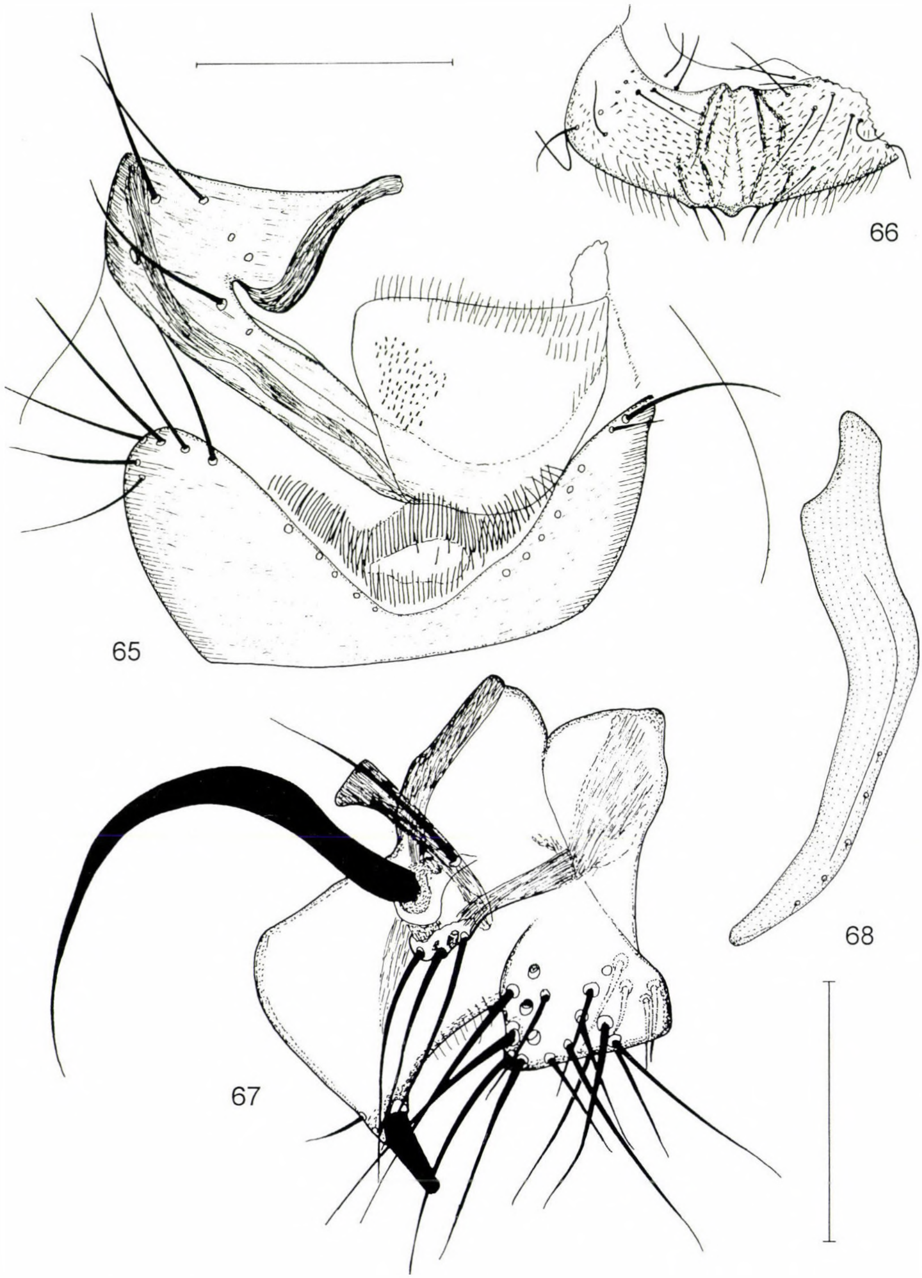
Frons dull greyish red, facial plate shiny, face, cheeks and genae reddish. Two pairs of strong orbital setae close to each other. Two pairs of short but not thin *ifr*. Genal seta only 0.125 mm long. Scape brown, pedicel yellow, first flagellomere reddish grey, covered with very dense white cilia. Pedicel is somewhat longer than first flagellomere (0.16 mm vs. 0.15 mm). Arista with short cilia only.

Mesonotum dull black with 4 sagittal, 4 pairs of dorsocentral and 3 pairs of lateral silvery spots. Anterior katepisternal thin and short. Scutellum as long as wide basally, concolorous with the mesonotum, with 6 silvery spots: 2 sagittal (basal and medial), 2 larger spots basolaterally including the bases of lateral scutellar setae and a pair of smaller spots on bases of apical scutellars.

Wing almost unicolorous light brown, veins yellow, only cross-veins lighter, one brown spot subapically on R_1, which also covers Rs fork, another spot on costa and wing plane proximally on second costal section and a third one around the upcurving section of R_{2+3}. Costal hairs short and less dense than in the *borboroides* group. Second costal section as long as third section. Vein R_{2+3} without a vein appendage subapically. Apical half of vein R_{4+5} straight, medial part more strongly curved.

All the femora and tibiae slightly thickened. Legs mainly dark brown but apical half of femora dorsally lighter (maybe the type specimens were kept in alcohol before pinning), tibiae with broad light ring medially and subapically. No parts of fore tarsomeres white but apical part of basitarsus and of the 2nd tarsomere light yellow, 3rd tarsomere wholly light yellow on all three tarsi. Male fore tibia and basitarsus with hairs much longer than diameter of tibia/basitarsus at their bases. Male mid tibia not curved inwards and not flattened, ventrally with shorter hairs (only some posterior hairs longer than tibial diameter). Mid tibia without a true ventroapical but with three, short, thick black setae instead. Mid tibial setae: no strong anterior or ventral seta, anterodorsals at 1/5 (short), at 3/10 (longer) at 11/15 (short) and at 5/6 (strong), posterodorsals (all strong) at 3/10, 3/5 and 5/6.

Male abdominal sternite 5 (Fig. 65) asymmetrical, medial part broadly emarginate, area between sternite 5 & 6 with long fine hairs arranged in 2 rows. Sternite 6 with a weakly sclerotized medial plate, which bears, asymmetrically, fine hairs as well as minute thornlets. Epandrium short with



Figs 65–68. *Poecilosomella subpilimana* sp. n., paratype male, postabdomen and genitalia. 65 = sternites 5 and 6, ventral view, 66 = subepandrial sclerite, caudal view, 67 = surstylus, lateral view, 68 = postgonite, lateral view. Scales: 0.2 mm for Fig. 65–66, 0.1 mm for Figs 67–68

short setae. Cerci normal. Subepandrial sclerite (Fig. 66) rather simple with a sagittal furrow, covered partly by black thornlets and with some medium long setae not only marginally. Male surstylus (Fig. 67) bilobed: anterior lobe incised apically, with numerous long setae, posterior lobe enlarged caudally with a strong apical tooth and subbasally with an extremely long flat thorn-like process. This process is curved mediocaudally, following the curvature of surstyli and epandrium, and is bordered by long, but slightly curved, setae. Postgonite (Fig. 68) rather simple: twice curved but medial part almost straight, with blunt apex and with a limited number of minute posterior hairlets.

Female unknown.

Distribution: Indonesia (Sumatra).

P. subpilimana sp. n. is not an easily recognisable species by body characteristics. It is hypothesized that this species is not a member of the species-group of *P. himalayensis, P. annulitibia* and *P. nepalensis*, centred in distribution in the Himalayas (see DEEMING 1969), although it keys with *himalayensis* on account of its similar wing venation and male mid tibial structures. The only reliable characters for its identification are in the male genitalia; in this respect it is similar to *P. pilimana* sp. n., particularly because of the extremely long black process (spine) on its surstylus.

A KEY TO THE ORIENTAL SPECIES OF POECILOSOMELLA (based on PAPP 1991*a*)

1 (14) Vein R_{2+3} with a distinct vein appendage (stump vein) subapically, i.e. at the turning point of curvature to costa.

2 (9) Second costal section much shorter than third. Male mid tibia and basitarsus without long cilia. No mid ventral seta on mid tibia.

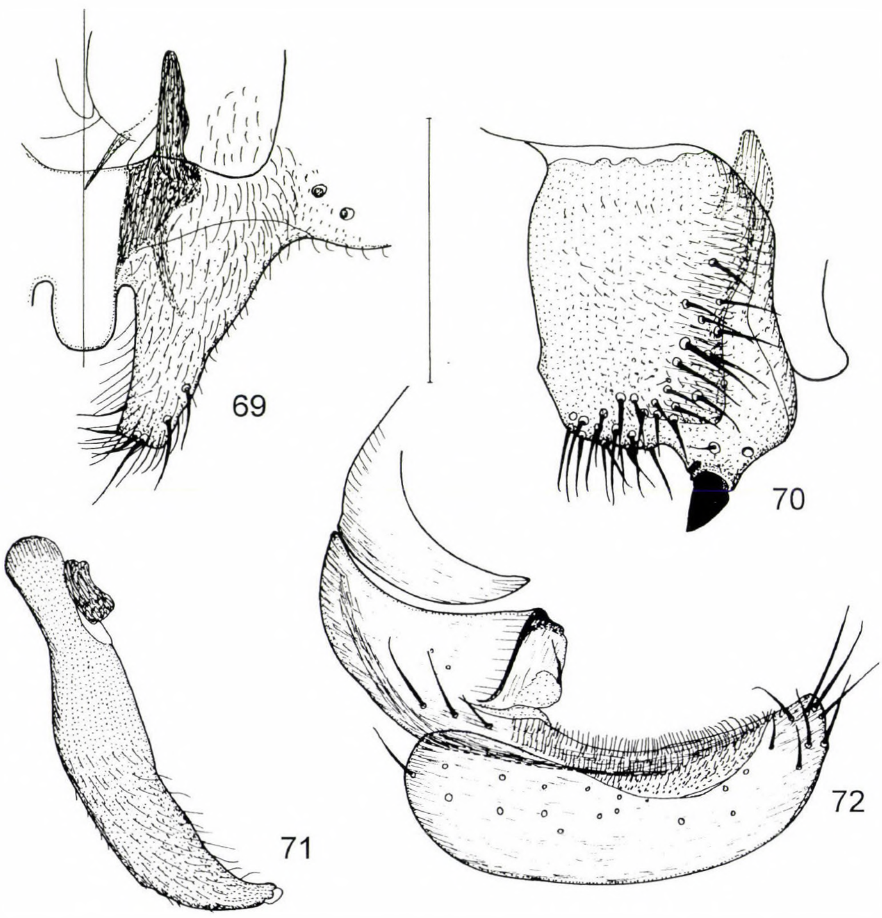
3 (4) No ventroapical on mid tibia, 3 thick, short setae instead. A long upcurved genal bristle present. Male fore tibia and 2 basal tarsomeres with long dense hairs on whole of ventral half. Surstylus very characteristic (PAPP 1991*a*: fig. 18), laterally with a long, curved, blade-like thorn. Postgonite (PAPP 1991*a*: fig. 20) much curved apically. Taiwan, Viet Nam *P. furcata* (DUDA, 1925)

4 (3) Mid tibia with a distinct ventro-apical seta.

5 (6) Wing with a diffuse dark brown spot on both sides of vein R_{4+5}, i.e. in middle of the r_{4+5} radial and medial cells. A long upcurved genal bristle present, much longer than genal diameter below eye, present. Male fore tibia and 2 basal tarsomeres with long dense hairs on whole of ventral half. Sabah **P. conspicua** sp. n.

6 (5) Wing evenly brown, without diffuse brown spots in middle of the r_{4+5} radial and medial cells. Genal bristle weak, shorter than genal diameter below eye. Male fore tibia and basal tarsomeres without long dense hairs.

7 (8) Ventroapical seta on mid tibia slightly curved and shorter than diameter of tibia subapically. Male surstylus (Fig. 14), postgonite (Fig. 15). Java, Sumatra *P. meijerei* (DUDA, 1925)



Figs 69–72. *Poecilosomella picturata* (MALLOCH), holotype male. 69 = right half of subepandrial sclerite, caudal view, 70 = surstylus, true lateral view, 71 = postgonite, lateral view, 72 = sternites 5 and 6, ventral view. Scale: 0.2 mm for Fig. 72, 0.1 mm for Figs 69–71

8 (7) Ventroapical seta of mid tibia much longer than diameter of tibia subapically. Taiwan **P. ronkayi** sp. n.

9 (2) Second costal section about as long as third. Male mid tibia and basitarsus with or without long cilia. Mid tibia with or without mid ventral seta. No strong upcurving genal bristle.

10 (11) Mid tibia without an anterior seta, or a small anterior close to the distal anterodorsal. Male mid tibia with a very long ventral spur (half as long as basitarsus). Female first flagellomere enlarged (much longer than scape and pedicel combined), with long cilia apically. Taiwan **P. longicalcar** sp. n., pro parte

11 (10) Mid tibia with a strong anterior seta. Male mid tibia with a short ventroapical seta, or ventroapical indiscernible. Female first flagellomere normal.

12 (13) Anterior bristle of mid tibia equidistant between the two strong anterodorsals. Male subepandrial sclerite with a blunt shovel-formed appendage. Postgonites arcuately curved and pointed. Nepal, Taiwan *P. annulitibia* (DEEMING, 1969)

13 (12) Anterior bristle of mid tibia much nearer to proximal anterodorsal than to long distal anterodorsal. Male subepandrial sclerite with a long medial process. Postgonites slightly curved and blunt apically. Nepal, India, Pakistan *P. nepalensis* (DEEMING, 1969)

14 (1) Vein R_{2+3} without a vein appendage subapically.

15 (24) Fore tarsomeres, and sometimes fore basitarsus partly, clear white. Second costal section much shorter than third.

16 (21) Costa terminates at vein R_{4+5}. Wings completely dark. Arista with long cilia (similar to that of *borboroides* and *ornata*) or genal bristle very small.

17 (18) Hind tibia all dark, without any light ring. Mid tibia with a long ventroapical seta (much longer than tibial diameter subapically). Genal seta very small. No ventral seta on the middle of mid tibia. Philippines, Sri Lanka *P. albipes* (DUDA, 1925)

18 (17) Hind tibia with one yellow ring medially and one apically. No ventroapical on mid tibia or ventroapical seta much shorter than tibial diameter subapically. Genal seta normal.

19 (20) Two pairs of thin but subequal orbital setae. No mid ventral seta on mid tibia. Second costal section only slightly longer than half third section. Vein R_{2+3} meets costa at an acute angle. Fore tarsomeres 2–5, mid and hind tarsomeres 3–5 clear white. Philippines **P. hayashii** sp. n.

20 (19) Anterior orbital seta reduced to a minute hair (just discernible), posterior orbital setae long and thick. Mid tibia with a strong mid ventral seta. Second costal section about 3/5 length of third section. Vein R_{2+3} meets costa perpendicularly. Fore tarsomere 5, as well as mid and hind tarsomeres 4–5 all dark. Sumatra **P. brevisecunda** sp. n.

21 (16) Costa terminates distinctly beyond tip of vein R_{4+5}. Wings lighter with dark spots (distinct pattern). No ventroapical on mid tibia or ventroapical seta much shorter than tibial diameter subapically.

22 (23) Costa terminates not far from apex of R_{4+5}. Male mid tibia with very long hairs and with straight stiff setae (DEEMING 1969: fig. 3). Nepal, India, Sri Lanka, Indonesia (W. Flores, Lombok) *P. aciculata* (DEEMING, 1969)

23 (22) Costa overruns apex of R_{4+5} by a distance of the length of dM-Cu cross-vein. Male mid tibia ventrally with a short ventro-apical but with short hairs only (shorter than tibial diameter). Sumatra **P. paraciculata** sp. n.

24 (15) No parts of fore tarsomeres white, although they are at least partly yellow.

25 (34) Arista with very long cilia. Costal hairs rather long. Second costal section much shorter than third. Male mid tibia and basitarsus ventrally without long hairs, or tibia with a limited number of long hairs.

26 (29) Mid tibia with a strong (antero)ventral bristle at apical 3/5 to 2/3 but no ventro-apical seta on mid tibia.

27 (28) Male surstylus (Fig. 12) with a large tooth and with a process caudally to it. Male subepandrial sclerite thinner digitiform without thicker setae (Fig. 11). Wing without a diffuse dark spot distally to apex of R_{2+3}. Widespread *P. ornata* (DE MEIJERE, 1908), sp. restit.

28 (27) Male surstylus with a small tooth and no process behind it (Fig. 70). Male subepandrial sclerite not curved, edged, broader with some thicker setae (Fig. 69). Wing with a diffuse dark spot distally to apex of R_{2+3}. Philippines *P. picturata* (MALLOCH, 1913), sp. restit.

29 (26) No ventral or anteroventral setae on mid tibia, except for the ventral seta at the apex.

30 (31) Antennae blackish. Wing with a diffuse dark spot distally to apex of R_{2+3}, male surstylus (Fig. 21) with a single tooth, i.e. without a row of thick black teeth. Taiwan **P. formosana** sp. n.

31 (30) Antennae reddish or yellowish. Wing without a diffuse dark spot distally to apex of R_{2+3}, male surstylus (Figs 4–5, 7) with a row of 4 or 6 thick black teeth.

32 (33) Male surstylus with 6 thick black teeth, ventral process of subepandrial sclerite (Figs 4–5) very broad, postgonite (Fig. 3) less broad. Widespread *P. borboroides* (WALKER, 1860)

33 (32) Male surstylus with 4 thick black teeth, ventral process of the subepandrial sclerite (Fig. 7) less broad, postgonite (Fig. 8) very broad. Philippines **P. borborus** sp. n.

34 (25) Arista with short cilia only. Costal hairs shorter. Second costal section usually as long as, or longer than third section.

35 (38) Scutellum very long, as long as apical scutellar setae or nearly so. Costal ratio *mg2*/*mg3* about 1.5 or even more. All posterodorsals on mid tibia short, i.e. no long paired setae on dorsal half of mid tibia. Male mid tibia with some short curved/inclinate ventroapical spurs.

36 (37) Body reddish, i.e. frons, face and genae red or reddish ochre, at least pleurae partly red. Four (rarely 3) pairs of short and thin *ifr*. Genae very broad, wings long. No upcurved genal bristle. Female cerci with 2 pairs of very long bent hairs. Nepal, India, Burma, China, Taiwan *P. longinervis* (DUDA, 1925)

37 (36) Body dark, e.g. mesonotum blackish brown. Only 2 or 3 pairs of short and thin *ifr*. Genae narrower than in *longinervis*, wings comparatively shorter. An upcurved genal bristle present. Female cerci with 1 short and 1 moderately long pairs of bristles only. India, Indonesia, Taiwan, Philippines *P. multipunctata* (DUDA, 1925)

38 (35) Scutellum normal. Second costal section variable but usually shorter. Mid tibia with at least 1 long posterodorsal seta, i.e. mid tibia with long paired setae. Male mid tibia with or without long ventroapical spur.

39 (42) Ventroapical seta (spur) of mid tibia very long, ca. half as long as mid basitarsus. Tibiae without light rings, at most apices lighter.

40 (41) Male mid tibia ventrally without long hairs. Surstylus long with an additional black lateral thorn on caudal lobe (DEEMING 1969: fig. 19). India *P. brunettii* (DEEMING, 1969)

41 (40) Male mid tibia with extremely long upright hairs. Surstylus (Fig. 25) shorter with several thick setae on caudal lobe. Taiwan **P. longicalcar** sp. n., pro parte

Aberrant males without an appendage on R_{2+3} run here.

42 (39) Mid tibia with or without long ventroapical spur; if present, much shorter than half length of mid basitarsus.

43 (50) Male tergite 5 broadened on right side with 9–13 extremely long thick marginal bristles. Posterior lobe of surstylus without apical tooth (Fig. 49). Vein R_{4+5} slightly bent towards costa.

44 (45) Male fore tibia without long hairs anteroventrally (hairs shorter than tibial diameter). Male mid tibia with medium-long hairs ventrally. Sri Lanka and Malaysia *P. pappi* HAYASHI, 1997

45 (44) Male fore tibia with extremely long hairs (some of the hairs longer than 1/3 length of fore tibia).

46 (47) Male fore tibia with extremely long hairs restricted to basal third of tibia. Male mid tibia ventrally with short (but thicker, stiff) hairs only. Biak I. and Papua New Guinea *P. insularis* HAYASHI, 1997

47 (46) Male fore tibia with extremely long hairs along its entire length (Fig. 48). Male mid tibia ventrally with long hairs (longer than tibial diameter).

48 (49) Hairs on male fore tibia at most slightly longer than 1/3 length of tibia (see fig. 5 of HAYASHI 1997). Anterior lobe of surstylus with shorter hairs (HAYASHI 1997: fig. 11), posterior lobe comparatively smaller. Christmas Island *P. pectiniterga* (DEEMING, 1964)

49 (48) Longest hairs on male fore tibia as long as 2/3 length of tibia (Fig. 48). Anterior lobe of surstylus with very long hairs (Fig. 49), posterior lobe larger than in *P. pectiniterga.* Philippines **P. pilipino** sp. n.

50 (43) Male tergite 5 normal, with the usual marginal bristles.

51 (52) Male mid tibia apically curved inwards and dorsoventrally flattened, ventrally with medium-long hairs. Male mid tibia apically without *va* seta but with a patch of short black spinules. Male fore tibia ventrally and posteriorly, as well as all fore tarsomeres with extremely long hairs. Large species, wing length 3.15 mm. Taiwan **P. curvipes** sp. n.

52 (51) Male mid tibia not curved inwards and not flattened. Usually smaller species.

53 (56) Apical half of vein R_{4+5} straight, medial part more strongly curved.

54 (55) Male mid tibia ventrally with very long hairs in distal 1/3 (DEEMING 1969: fig. 4); some of the ventral hairs thicker than adjacent ones. Male fore tibia and basitarsus posteriorly and posteroventrally with hairs shorter than diameter of basitarsus. Posterior lobe (ventromedial process) of male surstylus with a very long droplet-shaped apical tooth (DEEMING 1969: fig. 16). Nepal *P. himalayensis* (DEEMING, 1969)

55 (54) Male mid tibia ventrally with shorter hairs (only some posterior hairs longer than tibial diameter). Male fore tibia and basitarsus with hairs much longer than diameter of tibia/basitarsus at their bases. Posterior lobe (ventromedial process) of male surstylus (Fig. 67) with an extremely long, strap-like black spine. Sumatra **P. subpilimana** sp. n.

56 (53) Vein R_{4+5} more strongly bent towards the costa, i.e. apical part not straight, consequently medial part less curved (basal half slightly S-shaped).

57 (66) Male mid tibia ventrally with long hairs, no distinct, strong ventroapical seta but ventroapically at most with a transverse row of more or less curved, longer hairs instead. Male fore tibia ventrally and anteriorly, as well as fore basitarsus, or even other tarsomeres, with long hairs.

58 (59) Subepandrial sclerite ventrally with 6–7 long thick thorns (Fig. 51). Surstylar lobes very short, surstylus basally (caudally) with numerous short thick setae (Fig. 52). Sabah **P. sabahi** sp. n.

59 (58) Subepandrial sclerite normal, i.e. without long thick thorns ventrally. Surstylus otherwise shaped.

60 (63) Male mid tibia with ventral hairs strong, straight (stiff) but not longer than tibial diameter (at most some longer hairs subapically), some of the hairs blunt and thicker than adjacent hairs. Usually 4 short posterodorsals plus a longer preapical posterodorsal seta.

61 (62) Male ventral sclerites posterior to sternite 5 form two pairs of hairy processes (PAPP 1991*a*: fig. 26). Male surstylus (PAPP 1991*a*: fig. 30). Widespread *P. punctipennis* (WIEDEMANN, 1824)

62 (61) Male postabdomen with a single medial T or wide Y-shaped process (HAYASHI 2002). Male surstylus (HAYASHI 2002). Widespread *P. affinis* HAYASHI, 2002

63 (60) Male mid tibia with thinner but longer hairs, numerous hairs longer than tibial diameter; dorsal armature may be different.

64 (65) Male mid tibia ventroapically with a transverse row of 4–5 curved black thornlets. Surstylus without a large lateral process. Taiwan, Sumatra *P. amputata* (DUDA, 1925)

65 (64) Ventroapical part of male mid tibia with a patch of ca. 10 short black setulae. Epandrium dorsally with a pair of very long bristles. Surstylus (Fig. 43) laterally with an extremely long curved, posteriorly directed spine. Sumatra **P. pilimana** sp. n.

66 (57) Male mid tibia ventrally without long hairs, ventroapical seta more or less strong or mid basitarsus modified.

67 (72) Male fore tibia and basitarsus without long hairs. Female mid tibia with two short ventroapicals, which are much shorter than tibial diameter subapically.

68 (69) Male fore tibia ventrally with a row of black spines (Fig. 58). Surstylus (Figs 61–62, 64) with a pecten of 11 teeth. Sumatra **P. spinipes** sp. n.

69 (68) Male fore tibia ventrally without black spines.

70 (71) Male and female basitarsi normal. Vein R_{2+3} apically angularly bent to costa. Costa terminates at tip of vein R_{4+5}. Sumatra, Java, Taiwan, ?Burma *P. rectinervis* (DUDA, 1925)

71 (70) Male mid basitarsus with dense black setulae on its whole ventral surface. Female fore basitarsus, as well as hind 2nd tarsomere with short but very dense hairs; setulae on ventral surface of mid basitarsus also denser than usual. Vein R_{2+3} bent along a wide arc to costa. Costa overruns tip of vein R_{4+5} by a length equalling three times its diameter. Sumatra **P. peniculifera** sp. n.

72 (67) Male fore tibia and basitarsus (possibly other tarsomeres) posteriorly, or ventrally to posteriorly, with long hairs (longer than their diameter at bases of hairs).

73 (74) No yellow ring on middle of fore tibia. Facial plate not much protruding. Face, frons and genae dark brown. Hairs on male fore tibia and tarsomeres very long (some hairs more than twice longer than tibial diameter). Taiwan *P. nigrotibiata* (DUDA, 1925)

74 (73) A yellow ring on middle of fore tibia. Facial plate more convex. At least face or frons reddish or even lighter.

75 (76) Subepandrial sclerite laterally with (3-)4 long thick thorns (Figs 56–57). Surstylus (Fig. 54) medially with a thick but acute thorn and several strong setae. Postgonite (Fig. 55) strongly curved and rather broad. Apical part of first flagellomere markedly lighter than rest of flagellomere, also in females. Philippines, Tonga and Society Is. **P. spinicauda** sp. n.

76 (75) Subepandrial sclerite without thick thorns. Surstylus different.

77 (80) Male subepandrial sclerite with a pair of peculiar processes (Fig. 32). Surstylus trilobed with several thick thorns.

78 (79) Male subepandrial sclerite with a pair of large, broad, upcurved processes (PAPP 1991*a*: figs 33, 35). Postgonite (PAPP 1991*a*: fig. 34) geniculately bent, apical part not very broad. Widespread *P. varians* (DUDA, 1925)

79 (78) Male subepandrial sclerite with a pair of acutely pointed straight processes (Fig. 32). Postgonite (Fig. 31) bisinuate with broader, partly membraneous, apical part. Sri Lanka, Taiwan, probably widespread **P. nigra** sp. n.

80 (77) Male subepandrial sclerite simple (Fig. 39). Surstylus (Fig. 41) bilobed.

81 (82) Medial part of R_{2+3} slightly concave, i.e. no section parallel with costa. Posteromedial lobe of surstylus shorter and broader with a laterally placed thorn (PAPP 1991*a*: fig. 13). Postgonite (PAPP 1991*a*: fig. 15) less broad, caudal margin angulate. Subepandrial sclerite (PAPP 1991*a*: fig. 11). Taiwan *P. cryptica* L. PAPP, 1991

82 (81) A rather long medial part of R_{2+3} parallel to costa, apical part bent along a wide arc (i.e. not angulately) into costa. Posteromedial lobe of surstylus longer, apically with a bidentate thorn (Fig. 41). Postgonite (Fig. 40) very broad, caudal margin arcuately bent. Subepandrial sclerite (Fig. 39). Sabah **P. paracryptica** sp. n.

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COTESIA PAPPI SP. N. (HYMENOPTERA, BRACONIDAE: MICROGASTRINAE) FROM TURKEY

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A new species of the genus *Cotesia* CAMERON, 1891, *C. pappi* sp. n., is described and illustrated from Turkey. *C. pappi* sp.n., is compared to *Cotesia errator* (NIXON, 1974).

Key words: *Cotesia*, Microgastrinae, Braconidae, new species, Turkey

INTRODUCTION

Cotesia CAMERON, 1891 is the most common and ubiquitous genus of Microgastrinae, probably comprising 1500–2000 species. The genus of *Cotesia* is one of the largest and most difficult groups of the subfamily (NIXON 1974). Although most species of this genus are gregarious as larvae, about one quarter is solitary. The genus *Cotesia* CAMERON, 1891 differs from other Cotesini genera by having propodeum mostly rugose, and usually with a median and a short carina (MASON 1981).

Traditionally, the majority of Microgastrinae species has been placed in *Apanteles* by MARSHAL (1885) and MUESEBECK (1920). MASON (1981) split up the genus *Apanteles* FOERSTER into a series of genera. The *glomeratus* species-group is identical with the generic conception of *Cotesia* CAMERON, 1891. MASON (1981) treated this genus also in this comprehension.

MATERIAL AND METHOD

Three females were collected from Gullapoglu Arboretum of Trakya University, Edirne. Covering an area of 16 hectares, situated at an altitude of about 41 m. The most common vegetations occurring in this area are Leguminosae, Euphorbiacea and Compositaceae. While, *Ulmus minor* MILLER, *Acer tataricum* LINNÉ and *Salix alba* LINNÉ are the other species of secondary importance.

The definitions, ratios and abbreviations in this article follow that of PAPP (1986, 1987, 1988), NIXON (1974) and ACHTERBERG (1993). The following abbreviations are used in the text: OOL= ocular-ocellar line, POL= post ocellar line, LOL= lateral ocellar line. Figures were drawn and measurements taken using a camera lucida attached to a stereomicroscope.

Cotesia pappi sp. n. ♀
(Figs 1–6)

Material examined (3 ♀♀): Female holotype and two paratypes: "Turkey, Edirne, Gullapoglu Arboretum of Trakya University, 41m, 20.V.2001," holotype leg. A. ALADAG (TU), paratypes: 2 ♀♀, leg. S. YILMAZ (TU).

Holotype and two paratypes are deposited in the Zoological Museum of Department of Biology, Trakya University (TU), Turkey.

Etymology: Named in honour of Dr. JENŐ PAPP, excellent Hungarian specialist of Braconidae (Hymenoptera).

Description of the female holotype. – Length of body 2.6 mm. Head in dorsal view 2.1 times broader than long (Fig. 1). Temple 0.9 times broader than eye. OOL 0.8 times longer than POL and POL 3 times longer than LOL. Head in frontal view 1.27 times broader than its height. Lateral view of eye 1.8 times as high as wide. Cheek about 1.3 times longer than basal width of mandibles. Occiput almost smooth. Frons and vertex with very superficial fine punctation, subshiny. Antenna 21.1 times longer than first flagellomere and penultimate flagellomere just longer than broad (Fig. 2). Scape 0.6 times of its height.

Mesosoma: Length of mesosoma 0.69 times of its height. Mesonotum densely and deeply punctuated, subshiny. Notaulices densely, crowded punctated and dull. Scutellum shiny, anteriorly almost smooth, posteriorly superficial and sparsely punctated. Scutellar sulcus crenulated, its crenulae medially sparated. Mesopleuron shiny, smooth and rugulose basally. Precoxal suture crenulated. Propodeum subshiny, carinated and reticulate.

Legs: Inner side of hind coxa finely rugulose, outer side shiny, almost smooth, upper side with crowded punctation. Ratio of femur : tibia : basitarsus of hind leg: 27: 33: 16. Pair of spurs of hind tibia equal in length and hind tibial spurs about one-third as long as basitarsus (Fig. 3).

Wings: Fore wing (Fig. 4). Length of fore wing 0.75 times longer than body. Pterostigma 2.3 times as long as wide. Metacarp 0.9 times as long as pterostigma. Vein r 1.1 times as long as 2-SR. 2-CU1 twice longer than 1-CU1. Discal cell 0.6 times longer than its height. Nervellus of hind wing just not straight. Vannal lob faintly convex (Fig. 5).

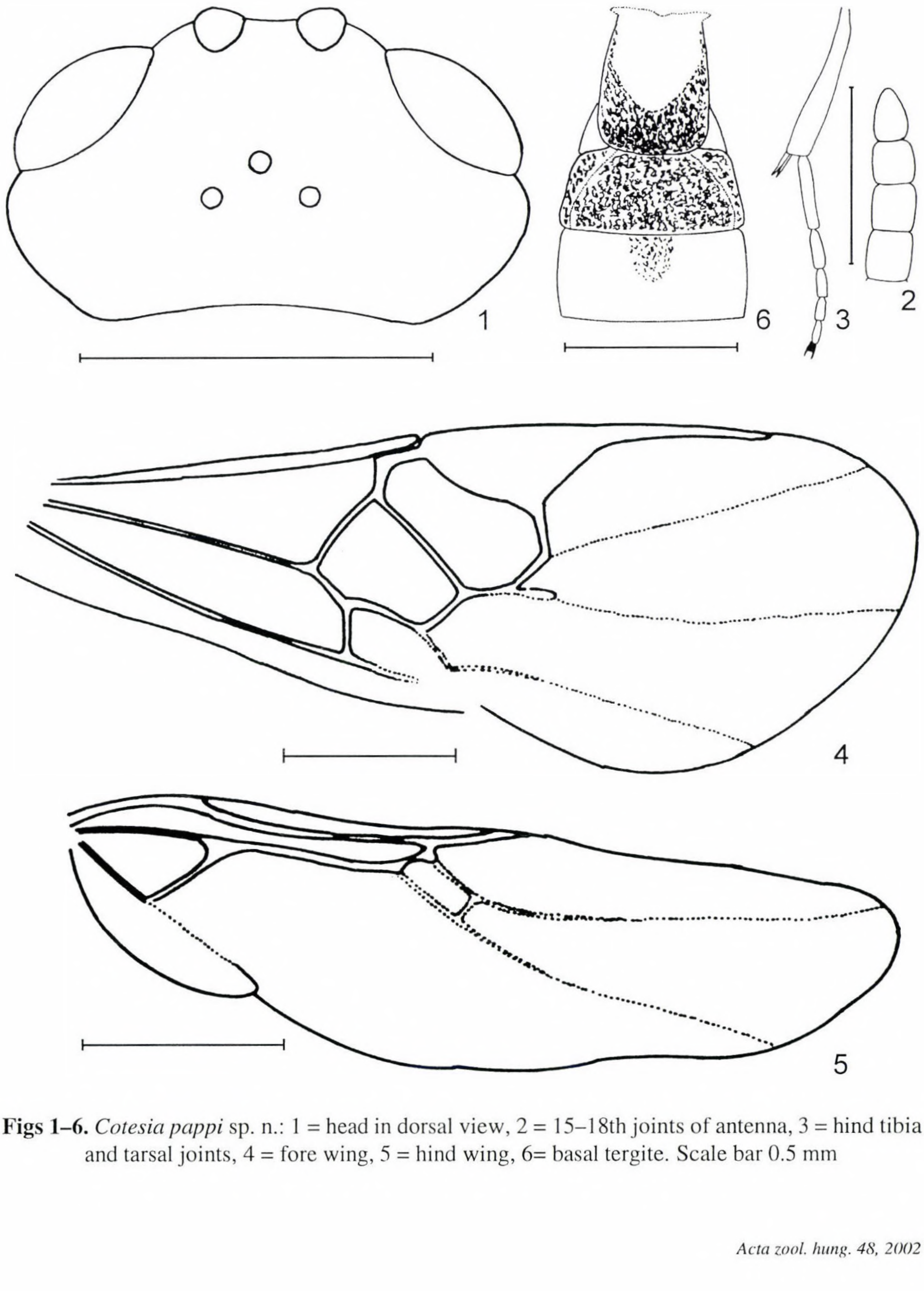
Metasoma: Length of metasoma 1.7 times longer than its height. First tergite 1.36 times longer than broad. First tergite almost smooth anteriorly and very shiny, but posteriorly rugose and subshiny. Second tergite similarly rugose than first tergite. Third tergite anterio medially slightly rugulose, shiny (Fig. 6). Hypopygium truncate, ovipositor sheath very short and concealed.

Colour: Body black. Stigma and veins brown. Tegula blackish brown. First and second tarsus dark brown, third tarsus brown.

Description of the two female paratypes. – Similar to the female holotype. Body 2.6–2.7 mm long (1 ♀: 2.6, 1 ♀: 2.7). Hind femur blackish (1 ♀), Second tarsus blackish brown (2 ♀♀).

Male and host unknown.
Distribution: Turkey.

The new species, *Cotesia pappi*, is nearest to *C. errator* (NIXON, 1974) considering their third tergite anteriorly rugulose-rugose, thrid tergite hardly longer



Figs 1–6. *Cotesia pappi* sp. n.: 1 = head in dorsal view, 2 = 15–18th joints of antenna, 3 = hind tibia and tarsal joints, 4 = fore wing, 5 = hind wing, 6= basal tergite. Scale bar 0.5 mm

than second tergite, hind femur black or blackish and inner spur of hind tibia as long as outer one; the two species are differentiated by the following features keyed:

1 (2) Penultimate joints of flagellum 1.2–1.3 times as long as broad. Scutellum subshiny, punctation equally fine, indistinct. Notaulices almost not indicated except as faint furrow. Mesonotum dull, finely punctated. Hind coxa evenly smooth, shiny. ♀: 3.2–3.4 mm *C. errator* NIXON

2 (1) Penultimate joints of flagellum a little longer than broad. Scutellum shiny, anteriorly almost smooth, posteriorly superficially sparsely punctate. Notaulices with closely crowded punctation, dull. Mesonotum densely, deeply punctated. Outer side of hind coxa shiny, almost smooth, upper side with crowded punctation. ♀: 2.6–2.7 mm **C. pappi** sp. n.

*

Acknowledgement – I am greatly thankful to Dr. JENŐ PAPP for his help in describing the new species. I am grateful to Dr. LAJOS ZOMBORI and Dr. J. PAPP for providing me facilities at the Department of Zoology, Hungarian Natural History Museum (Budapest). Also sincere to thanks to AYLA ALADAG and SENAY YILMAZ (graduate students at the Department of Biology, Trakya University, Turkey) for collecting the samples for identification.

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DRAGONFLY ASSEMBLAGES OF A SHALLOW LAKE TYPE RESERVOIR (TISZA-TÓ, HUNGARY) AND ITS SURROUNDINGS

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The dragonfly fauna of the typical water bodies of the Reservoir Tisza-tó was characterised based on a two-year study. We collected 728 imagoes, 384 larvae and 194 exuviae during the study, and there were 101 observations of imagos. We confirmed the presence of 39 species (13 Zygoptera and 26 Anisoptera).
We distinguished 5 types of water bodies inside and around the Reservoir Tisza-tó: leaking canals, a new inundated area of the reservoir, native water bodies inside the reservoir, in- and outflows, and River Tisza inside the reservoir. Both traditional diversity statistics and scalable diversity characterisation suggested that the most species-rich were the native water bodies, with a species-pool of 34 species; there were 30 species in the in- and outflows, while the leaking canals and the reservoir were moderately species-rich with 25 species each. The River Tisza was relatively species-poor compared to the other water bodies (12 species). Cluster analysis of the species composition revealed that the fauna of the River Tisza is clearly separated from the other water bodies. The fauna of the new inundated area, the native water bodies, and the in- and outflows were similar; these water bodies had direct connection to the reservoir. The fauna of the leaking canals was slightly different from them.

Key words: dragonflies (Odonata), lowland reservoir, Tisza, biodiversity, typical water bodies

INTRODUCTION

Dragonflies are key organisms of the food web as predators both as larvae and as imagoes (BENKE 1976). They usually have definite habitat preference and territorial behaviour (CORBET 1999). The taxon has relatively few species which can be identified in the field. They are usually abundant and sensitive indicators of the structural changes of their habitats, and the changes of the water quality caused by biotic and/or abiotic factors (BULÁNKOVÁ 1997, CHWALA & WARINGER 1996, LENZ 1991, MÜLLER *et al.* 2002, SCHMIDT 1985). There are standard techniques to estimate their composition and abundance (DÉVAI 1997*a*). Therefore, they are especially useful for habitat assessment, producing comparable results even in local, regional or larger scale. All of these features make the dragonflies a very useful group of animals for habitat assessment and biodiversity monitoring, especially in

the case of shallow lakes or the running water of the Great Hungarian Plain (DÉVAI 1997*b*).

The study period lasted for two years, because we wanted to provide a complete collection of the species of the Reservoir Tisza-tó. Besides the extensive faunistic survey of the Reservoir Tisza-tó we wanted to explore the major differences between the characteristic types of water bodies based on the dragonfly fauna.

There are a few publications about the fauna of this area before the establishment of the Reservoir Tisza-tó (BENEDEK *et al.* 1973, STEINMANN 1959*a*, *b*, 1962, TÓTH 1974, 1998). KÁTAI and DÉVAI (1978) published data about the dragonfly fauna of the Reservoir Tisza-tó after the establishment.

MATERIALS AND METHODS

Study area

The Reservoir Tisza-tó (or sometimes it is mentioned as Kiskörei-tározó) is the second largest water body in Hungary, which was created in 1973 on the River Tisza. It is located in the Middle-Tisza-Region, between the 404 and 440 river km; its length is 33 km and the average depth is approximately 1.3 m. The total area is 127 km^2. Its largest width is 6.58 km and the smallest is 0.6 km. The water level varies strongly depending on damming. Only a small part of the reservoir is covered by water during the whole year; it gets dry partly after the water drainage in winter. There are several oxbows close to the main water body of the reservoir; these were caused by the regulation of the River Tisza. A leaking canal system surrounding the reservoir, returns the accumulated groundwater into the lake. Three creeks [Laskó, Rima (Eger-patak) and Nyárád-ér] also carry water into the main reservoir. Three large canals (Nagykunság, Jászság and Tiszafüred canals) provide the irrigation-water supply to the surrounding areas. A considerable part of the area belongs to the nature conservation area of the Hortobágy National Park.

Sampling methods

Samples were collected during 1998 and 1999. Altogether, we spent 52 days field tracking and collecting samples. Imagoes of dragonflies were collected by a steel framed net with the bag made from curtain-textile or soft plastic net-textile. Exuviae were collected individually. Larvae were collected by sweep sampling using a standard hand net usually used in limnology. The following keys were used for identifying the imagoes: ASKEW (1988), BENEDEK (1965), DREYER (1986), and STEINMANN (1984). Exuviae and larvae were identified by the keys of ASKEW (1988), GERKEN and STERNBERG (1999), HEIDEMANN and SEIDENBUSCH (1993). The collected specimens were stored in ethyl-alcohol.

Data were collected from five types of water bodies inside and around of the Reservoir Tisza-tó, altogether from 55 localities. These characteristic water bodies are as follows:

(1) Leaking canals around the Reservoir Tisza-tó: This is a drainage canal system which makes possible to return the collected groundwater to the reservoir by pumping stations. There were 18 sampling locations of this kind.

(2) The new inundated area of the reservoir: Samples were collected along the shore of the basins (at Abádszalók, at Poroszló, at Tiszavalk) of the Reservoir Tisza-tó. There were 19 sampling locations. These locations run dry during the winter.

(3) Native water bodies inside the reservoir: These are topographically well confined water bodies located inside the reservoir, which are recognizable on the field, because they were cut off oxbows or streams within the area of reservoir before the establishment of it. There were 8 sampling locations. These are covered by water during the whole year.

(4) In- and outflows: These are watercourses that flow into the reservoir (the Creek Rima, Laskó, Nyárád-ér) and the two canals that rise from the reservoir (Jászsági-főcsatorna and Nagykunsági-főcsatorna). Each of the sampling locations was within 2 km of the reservoir. There were 5 sampling locations

(5) The River Tisza: This is a narrow riverside margin of the river. The whole studied bed of the River Tisza was inside the reservoir, although it was connected to the reservoir only in the case of extremely high water level. There were 5 sampling locations.

Data analyses

Scalable diversity characterization was used to display the species richness of the dragonfly fauna of the water bodies. The calculation was based on the relative frequency occurrence data. Rényi's diversity profile was used (TÓTHMÉRÉSZ 1998). As a special case it includes the logarithm of the species number, the Shannon diversity index, the quadratic or Simpson diversity index, and the logarithm of Berger–Parker diversity (TÓTHMÉRÉSZ 1995). Therefore, it is a family of diversity indices. It is proposed to use for diversity comparisons (SOUTHWOOD & HENDERSON 2000). It has a so-called scale parameter. When the value of the scale parameter is low the method is extremely sensitive to the presence of rare species. When the value of the scale parameter increases the diversity is less sensitive to the rare species than earlier. For a large scale parameter value the method is sensitive only to the frequent species. The result of this scale-dependent characterization of diversity can be used in a graphical form to visualize the diversity relations of communities. When we are using a one-parameter family $D(a)$ of diversity indices, then the family may be portrayed graphically by plotting $D(a)$ against the (scale) parameter a. This curve, the graph of the $D(a)$ diversity index family, frequently mentioned as the diversity profile of the community. Basically, a serves as a scale parameter, and members of the $D(a)$ diversity index family have different sensitivity to the rare and frequent species depending on a, which may be regarded as a scale parameter. It is important to stress that the curves of two diversity profiles may intersect. For two communities, the intersection of the diversity profiles means that one of the communities is more diverse for the rare species, while the other one is more diverse for the frequent species.

Rogers–Tanimoto index was used to measure the similarity of the species composition of the dragonfly fauna of the compared water bodies, and the single average method was used during the cluster analysis (LEGENDRE & LEGENDRE 1998).

BioBev program package was used for data management (HORVÁTH *et al.* 1997). Diversity analyses and cluster analysis were performed by the NuCoSA package (TÓTHMÉRÉSZ 1993).

Table 1. Country-wide occurrence categories, and local relative occurrence frequencies of the dragonfly species for the suborder Zygoptera in the studied water bodies. Notations: V – very frequent, IV – frequent, III – less frequent, II – rare, I – sporadic.

Taxon	Country-wide	Local
Ischnura elegans pontica SCHMIDT, 1938	IV	0.211
Coenagrion puella puella (LINNÉ, 1758)	IV	0.130
Erythromma viridulum viridulum CHARPENTIER, 1840	III	0.126
Platycnemis pennipes pennipes (PALLAS, 1771)	IV	0.126
Coenagrion pulchellum interruptum (CHARPENTIER, 1825)	IV	0.114
Lestes sponsa sponsa (HANSEMANN, 1823)	IV	0.114
Agrion splendens splendens (HARRIS, 1782)	IV	0.057
Erythromma najas najas (HANSEMANN, 1823)	III	0.053
Sympecma fusca (VAN DER LINDEN, 1820)	V	0.028
Ischnura pumilio (CHARPENTIER, 1825)	IV	0.016
Lestes barbarus (FABRICIUS, 1798)	IV	0.016
Lestes virens vestalis RAMBUR, 1842	IV	0.004
Chalcolestes viridis viridis (VAN DER LINDEN, 1825)	II	0.004

RESULTS

There were 728 imagoes, 384 larvae and 194 exuviae collected during the study, which correspond to 780 data items (543 imagoes, 154 larvae and 83 exuviae). Additionally there were 101 imago data items resulting from observations. All of these data items were recorded as presence/absence data irrespective of the number of individuals actually collected or observed. Altogether, the total number of data items was 881. As the result of the research we confirmed the presence of 39 species (13 Zygoptera and 26 Anisoptera) altogether. The collected and/or observed dragonfly fauna of the Reservoir Tisza-tó is shown in Table 1 for the Zygoptera and in Table 2 for the Anisoptera, as well as the country-wide occurrence frequency (DÉVAI *et al.* 1994) and the local occurrence frequency.

The most species-rich were the native water bodies, with 34 species; there were 30 species in the in- and outflows, while the leaking canals and the reservoir were moderately species rich with 25 species. The River Tisza was relatively species-poor compared to the other water bodies; 12 species were identified. The total number of collected species for the studied water bodies, separately for the two suborders, are shown in Figure 1.

Scalable diversity characterization, provided by the diversity profiles of the water bodies, is displayed by Figure 2; it is evident that the native water bodies

Table 2. Country-wide occurrence categories, and local relative occurrence frequencies of the dragonfly species for the suborder Anisoptera in the studied water bodies. Notations as in Table 1.

Taxon	Country-wide	Local
Crocothemis servilia servilia (DRURY, 1770)	III	0.103
Sympetrum depressiusculum (SÉLYS-LONGCHAMPS, 1841)	III	0.099
Sympetrum sanguineum sanguineum (MÜLLER, 1764)	IV	0.099
Orthetrum albistylum albistylum (SÉLYS-LONGCHAMPS, 1848)	III	0.088
Sympetrum vulgatum vulgatum (LINNÉ, 1758)	IV	0.088
Orthetrum cancellatum cancellatum (LINNÉ, 1758)	III	0.076
Aeshna mixta LATREILLE, 1805	IV	0.065
Anax imperator imperator LEACH, 1815	III	0.065
Anaciaeschna isosceles isosceles (MÜLLER, 1767)	III	0.053
Sympetrum meridionale (SÉLYS-LONGCHAMPS, 1841)	IV	0.042
Gomphus flavipes flavipes (CHARPENTIER, 1825)	II	0.031
Anax parthenope parthenope (SÉLYS-LONGCHAMPS, 1839)	I	0.027
Aeshna affinis VAN DER LINDEN, 1820	IV	0.023
Brachytron pratense (MÜLLER, 1764)	III	0.023
Cordulia aeneaturfosa aeneaturfosa FÖRSTER, 1902	II	0.023
Sympetrum flaveolum flaveolum (LINNÉ, 1758)	IV	0.019
Sympetrum striolatum striolatum (CHARPENTIER, 1840)	IV	0.015
Leucorrhinia caudalis (CHARPENTIER, 1840)	I	0.011
Libellula quadrimaculata quadrimaculata LINNÉ, 1758	III	0.011
Libellula fulva fulva MÜLLER, 1764	II	0.008
Epitheca bimaculata bimaculata (CHARPENTIER, 1825)	I	0.008
Sympetrum pedemontanum pedemontanum (ALLIONI, 1766)	I	0.008
Gomphus vulgatissimus vulgatissimus (LINNÉ, 1758)	III	0.004
Aeshna viridis EVERSMANN, 1836	I	0.004
Orthetrum coerulescens anceps (SCHNEIDER, 1845)	III	0.004
Sympetrum fonscolombii (SÉLYS-LONGCHAMPS, 1840)	II	0.004

were the most diverse; the in- and outflows were the second most diverse. The leaking canals were more diverse than the reservoir, and the River Tisza was the less diverse.

The cluster analysis of the species composition of the dragonfly fauna showed that the species composition of the River Tisza was very different from the others, while the fauna of the other water bodies were similar to one another (Fig. 3). The most similar was the species composition of the native water bodies, and the in- and outflows. The fauna of the reservoir was also similar to them.

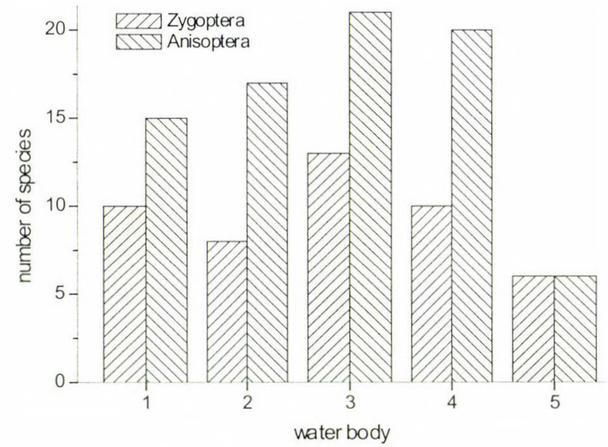


Fig. 1. Species richness of the dragonfly fauna of the water bodies, separately for the two suborders. Notations: 1 = leaking canals, 2 = new inundated area, 3 = native water bodies, 4 = in- and outflows, 5 = River Tisza

DISCUSSION

We identified 39 species: 13 Zygoptera and 26 Anisoptera. This was 60 per cent of the whole Hungarian Odonata fauna. We compared the species richness of the studied water bodies (Fig. 1). Species richness of the Reservoir Tisza-tó was the smallest. Majority of the dragonfly species of the Hungarian fauna preferred standing waters and there were only a few species living in larger streams as were

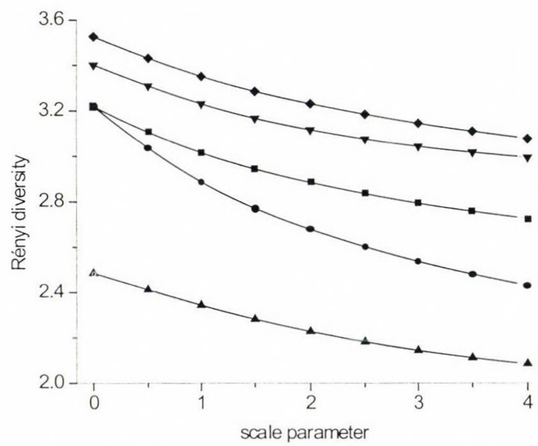


Fig. 2. Diversity profiles of the studied water bodies. Notations: ■ = leaking canals, ● = new inundated area, ♦ = native water bodies, ▼ = in- and outflows, ▲ = River Tisza

reported by DÉVAI and MISKOLCZI (1987). This was also the case for the studied water bodies. Even nowadays, three decades after the establishment, the most species-rich were the native water bodies inside the reservoir.

In- and outflows were very important from the point of view of colonizing of the reservoir. It resulted in large species richness because both the dragonflies of the creeks and standing water habitats were represented. In these water bodies we demonstrated the presence of many species with sporadic, rare and moderately frequent occurrence according to the country-wide occurrence frequency (DÉVAI *et al.* 1994). Among these there was a species, which was found only here [*Orthetrum coerulescens anceps* (SCHNEIDER, 1845)].

The native water bodies contained water during the whole year, and they were under the control of the nature conservation auspices of Hortobágy National Park. Because they were permanent, the number of species was the highest here. It was remarkable that some nationally sporadic species [*Anax parthenope* (SÉLYS-LONGCHAMPS, 1839); *Aeshna viridis* EVERSMANN, 1836; *Leucorrhinia caudalis* (CHARPENTIER, 1840) and *Epitheca bimaculata* (CHARPENTIER, 1825)] appeared here. There were two highly protected species of the Bern Convention: *Leucorrhinia caudalis* (CHARPENTIER, 1840) and *Aeshna viridis* EVERSMANN, 1836. There were four species [*Lestes virens vestalis* RAMBUR, 1842, *Chalcolestes viridis* (VAN DER LINDEN, 1825), *Leucorrhinia caudalis* (CHARPENTIER, 1840) and *Aeshna viridis* EVERSMANN, 1836] which were found only in these water bodies.

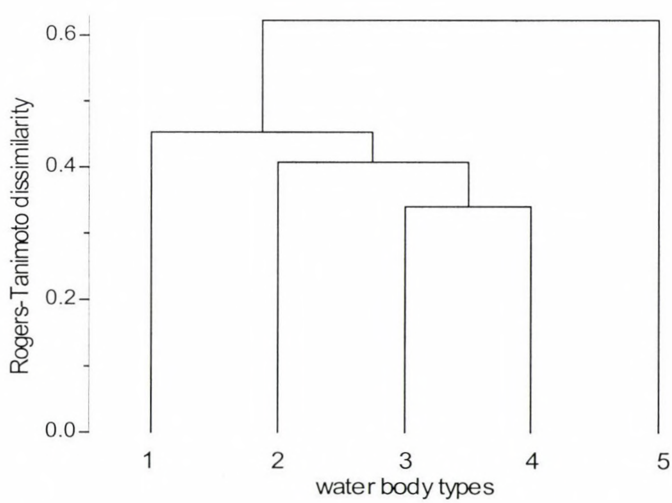


Fig. 3. Hierarchical cluster analysis of the water bodies. Rogers–Tanimoto dissimilarity and single average fusion algorithm were used. Notations: 1 = leaking canals, 2 = new inundated area, 3 = native water bodies, 4 = in- and outflows, 5 = River Tisza

Despite the relatively high number of species of the reservoir at the individual sampling locations numbers were low. This means that the reservoir was not homogeneous. In comparison with the other water bodies the high species richness of the reservoir reflected the effect of some especially rich habitats (e.g. 14 or 18 species). At the same moment only a few species were collected in the basin at Abádszalók (e.g. 1, 3 or 5 species). The composition of the dragonfly fauna of the basin at Abádszalók reflected the negative consequences of a profound human influence. Bathing and other aquatic sports (motor-boat and jet ski) resulted in the impoverishment of the local fauna through destruction of the submerged macro-vegetation and marshy vegetation. Mole stones deposited along the beach also increased the disturbance. The stones also hindered the settlement of marshy vegetation. Under these conditions only a few dragonfly species [*Platycnemis pennipes* (PALLAS, 1771), *Ischnura elegans pontica* SCHMIDT, 1938, *Orthetrum cancellatum* (LINNÉ, 1758), *Orthetrum albistylum* (SÉLYS-LONGCHAMPS, 1848)] can survive; these tolerated the disturbance better than the other species (MÜLLER *et al.* 2003).

The average number of species was also low in the leaking canals. There was a strong human influence in this type of water body. The high fluctuation of the water level and the excavation of the channel had strong influence on the dragonfly fauna, limiting the diversity. There was just one species [*Sympetrum fonscolombii* (SÉLYS-LONGCHAMPS, 1840)] which was detected only in this water body type.

The river Tisza was species-poor. There were three species characteristic to the river: *Gomphus flavipes* (CHARPENTIER, 1825) *Gomphus vulgatissimus* (LINNÉ, 1758); *Agrion splendens* (HARRIS, 1782). There was a generalist species, *Platycnemis pennipes* (PALLAS, 1771), which was also frequent.

Using the scalable diversity characterization (Fig. 2) the following order of the diversity of dragonfly fauna of the studied water bodies has been formed. The River Tisza was the least diverse both for the frequent and the rare species, as was expected in the case of rivers. It is followed by the reservoir; then the leaking canals, followed by the in- and outflows. Finally, the native water body was the most diverse type of the water bodies. The diversity profiles of the dragonfly fauna of the water bodies did not cross each other, which means that the orders according to the diversity were the same for the rare, moderately frequent, and the frequently occurring species. This may be interpreted in the following way: the basic structure of the fauna was similar for the whole set of studied water bodies. Each water body was characterized by a stable or relatively stable, typical dragonfly assemblage. In the case of dramatic changes of the fauna and/or strong degradation, or in the case of unstable faunistic composition the shape of the diversity profiles are usually different and they cross each other. This was not the case for the studied water bodies.

Based on the cluster analysis of the faunistic composition of the studied water bodies the reservoir, the native water bodies, and the in- and outflows were similar (Fig. 3.). These water bodies had direct connection to the reservoir. By the clusteranalysis they constitute essentially a group of closely similar water bodies based on the similarity of their dragonfly fauna. In the case of the leaking canal system there was no direct connection to the reservoir; these were connected to the reservoir by pumping stations. The dragonfly fauna of this water body type was slightly separated from the previous group of water bodies. The River Tisza separated with the highest level from the others by the cluster analysis. It was lower in every species richness measure compared to the other four water body types.

*

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A NEW GENUS AND SPECIES OF THE SUBTRIBE ANISODACTYLINA FROM SOUTH-WESTERN AUSTRALIA (COLEOPTERA: CARABIDAE: HARPALINI)

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The new monotypical genus *Nornalupia* gen. n. with new species *N. megacephala* sp. n. are described from the Nornalup-Walpole Nature Park, south-western Australia. The taxonomic position of the new genus within the subtribe Anisodactylina is discussed.

Key words: Coleoptera, Carabidae, Harpalini, Anisodactylina, *Nornalupia*, Australia, new genus, new species

INTRODUCTION

The supra-specific system of the subtribe Anisodactylina is the most advanced and phylogenetically the most substantiated within Harpalini thanks largely to the fundamental works of NOONAN (1973, 1976). This subtribe comprises about 40 valid genera and subgenera with about 340 species distributed in all major zoogeographical regions, predominantly in temperate zones. The Australian fauna has not been adequately studied and needs revision. The modern catalogue of all described taxa with information about their distribution has been published by MOORE *et al.* (1987). The Australian Anisodactylina includes the rather primitive genera *Gnathaphanus* MACLEAY, 1825, *Cenogmus* SLOANE, 1898, *Hypharpax* MACLEAY, 1825, and *Notiobia* PERTY, 1830, which all are characterized by the plesiomorphic condition of labium with complete transverse suture between mentum and submentum. Of these genera, only *Cenogmus* is endemic to Australia, other genera extend more widely but, except for *Notiobia*, are most diverse also in the Australian region. The rather diverse genus *Notiobia* (sensu lato) is distributed in the New World, Africa and Australia.

While working on the collections of Harpalini in the Hungarian Natural History Museum, Budapest, I found a series of the highly peculiar species of the tribe Anisodactilina captured in the Nornalup-Walpole Nature Park, south-western Australia, which, in my opinion, belongs to a new species and a new genus. Their descriptions are provided in the present paper.

MATERIAL AND METHODS

The holotype of the new species is deposited in the Australian National Insect Collection (ANIC), Canberra. Most of the paratypes are kept in the collection of Hungarian Natural History Museum, Budapest, and some in the collection of Zoological Institute of the Russian Academy of Sciences, St. Petersburg.

Measurements were taken as follows: body length from anterior margin of clypeus to elytral apex; width of head as maximum linear distance across head, including compound eyes, and as minimum linear distance across neck constriction just behind eyes; length of pronotum along its median line; length of elytra from basal ridge in scutellar region to apex of sutural angle; width of pronotum and elytra at their broadest place.

Nornalupia gen. n.

Type species: *Nornalupia megacephala* sp. n.

Diagnosis – Head very large, punctate dorsally and with small eyes widely separated from buccal fissure ventrally; fronto-clypeal suture deepened and continuing to deep clypeo-ocular prolongation; mentum with prominent medial tooth and separated from submentum by complete transverse suture; ligula not expanded at apex and with only two ventroterminal setae; elytra each with one discal pore on 3rd interval and without scutellar stria; first metatarsomere rather long; and anal sternite in male with one pair of setae at apical margin.

Description – Wingless. Body small, elongate and convex, glabrous on dorsal side.

Head very large, longer and only a little narrower than pronotum, distinctly, even if finely and sparsely, punctate dorsally, with small flat eyes very broadly separated from buccal fissure ventrally; genae broad, nearly as wide as eyes (Fig. 1). Temples long, very convex and rather abruptly descending to neck. Fronto-clypeal suture clearly deepened, continuing posterio-laterally towards eyes as rather deep clypeo-ocular prolongation reaching inner margin of eye; additional groove extended from clypeus to apical portion of supraorbital furrow externally of clypeo-ocular prolongation and parallel to it forming convex bead at base of mandible. Labral apex not concave, more or less straight. Clypeus with one lateral setigerous pore on each side, scarcely emarginate anteriorly and labral base not exposed. Mandibles stout, left clearly truncate at apex (Fig. 2). Labium (Fig. 7) with mentum and submentum completely separated by transverse suture. Submentum with two lateral setae on each side (inner seta much longer than external). Mentum with well developed acute median tooth and with a pair of median setae. Ligular sclerite moderately broad, not expanded apically, with two ventroterminal setae and without dorsal setae. Paraglossae glabrous, narrow, notably extending beyond ligular sclerite and separated distally from it by deep notch. Penultimate labial palpomere approximately as long as terminal, with two long and several (3–4) shorter setae at anterior margin and with one ventroapical seta. Antennae slender, pubescent from apical half of 3rd segment on.

Pronotum relatively small and convex, with unisetose sides convergent basad. Anterior margin bordered only laterally, bead along posterior margin complete. Surface, except for small central part, coarsely punctate. Basal pronotal edge glabrous.

Elytra oblong-oval, moderately convex, with prominent angulate humeral angles and somewhat deep subapical sinuations. Striae slightly deepened, either smooth or irregularly punctate and weakly crenulate. Ninth stria separated from lateral furrow by narrow flat area. Seventh stria with ocellate pore before apex. Scutellar stria absent, basal pore large, separated from basal edge. Intervals weakly convex, in some specimens covering by indistinct punctation. Third interval with one discal pore behind middle (in one specimen with two on one elytron); 5th and 7th intervals without pores. Marginal series widely interrupted medially, consisting of basal and apical groups of umbilicate pores. Basal elytral edge glabrous.

Ventral surface of body, except for obligatory setae and very fine pubescence on pro- and metasternum, glabrous. Apex of prosternal lobe with several setae. Anal sternite rounded at apex (in male sometimes scarcely truncate), with one pair of setigerous pores along apical margin in male and with two pairs in female. Apex of anal tergite in both sexes roundly angulate but in male more narrowly than in female.

Legs slender. Fore tibia with two apical spines at outer margin and one spine at apex of very small ventroapical tubercle; apical spur slender, lanceolate. Hind femur with two setigerous pores at hind margin. Tarsi dorsally impunctate and glabrous; fifth segment with usually two, sometimes three pairs of latero-ventral setae. Metatarsus shorter than width of head measured at neck constriction; 1st segment slender, approximately as long as 2nd and 3rd together and about three times as long as wide at its apical part. Pro- and mesotarsi of male weakly dilated and carring spongy adhesive vestiture underneath.

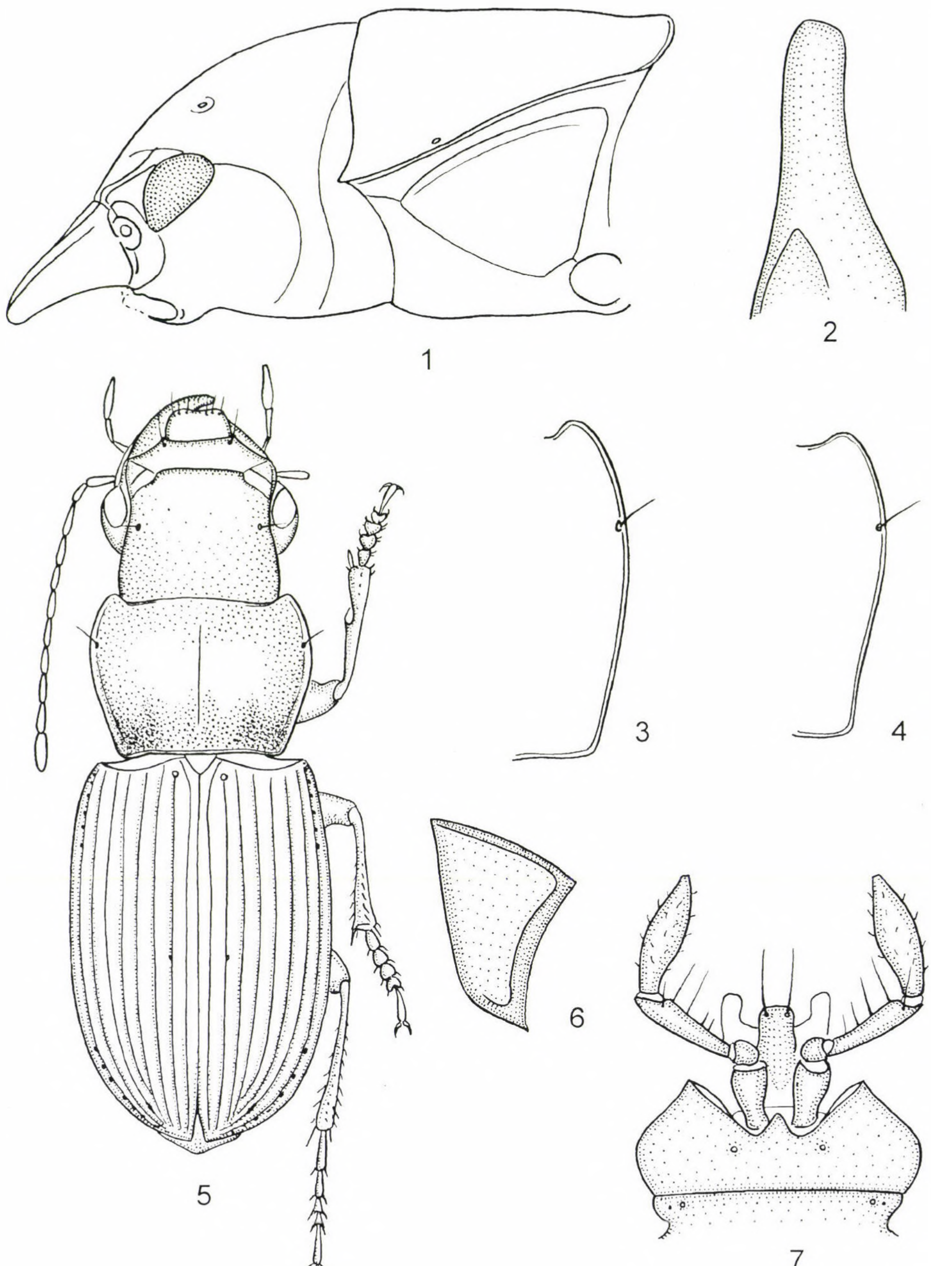
Median lobe of aedeagus (Figs 8–9) without any apical capitulum, with apical orifice in dorsal position and with membranous area widely extending to large basal bulb.

Female genitalia (Figs 10–11): valvifer broad, weakly sclerotized apically and with 1–3 fine distal setae. Stylus with basal segment rather short, markedly widened apically, with two short distal setae; apical segment arcuate, somewhat sharp apically, with one seta on inner margin before apex.

Etymology – The generic name is female, referring to the type locality, Nornalup-Walpole Nature Park.

Included species – The new genus includes a single species *Nornalupia megacephala* sp. n. from south-western Australia.

Remarks – In appearence, this new genus resembles some small representatives of the genus *Chydaeus* CHAUDOIR, 1854 but possesses the labium with mentum and submentum separated by a complete transverse suture and therefore, like all the other Australian taxa of the subtribe Anisodactylina, belongs to the notiobioid main branch sensu NOONAN (1973). Within this branch, the genus seems to be rather separated from other groups and is well recognizable on the basis of the combination of characters listed in the diagnosis. Some of these characters (small eyes, well dentate mentum, comparatively narrow apex of ligula, one pair of setae on anal sternite of male) are common to both *Nornalupia* gen. n. and the New Zealand genus *Allocinopus* BROUN, 1903, but the latter is easily distinguished by having the frontal fovea punctiform, metepisterna wider than long, anal sternite of female with only one pair of setae and median lobe of aedeagus with shorter membranous area. Based on rather long first segment of hind tarsus and



Figs 1–7. *Nornalupia megacephala* sp. n. Head and pronotum, lateral apect (1). Apex of left mandible, frontal aspect (2). Right margin of pronotum (3–4). Habitus (5). Right metepisternum (6). Labium (7). Scales: A = 1 mm (Figs 1, 3–4), B = 0.5 mm (Figs 2, 6, 7), C = 1 mm (Fig. 5)

presence of only one discal pore on third elytral interval, the new genus seems to be most related to the genus *Notiobia* PERTY, 1830 represented in Australian Region by the subgenus *Anisotarsus* CHAUDOIR, 1837 (= *Diaphoromerus* CHAUDOIR, 1843) but well differs in rather peculiar characteristics of the head (great size, presence of dorsal punctation, very broad genae, deepened fronto-clypeal suture continuing to deep clypeo-ocular prolongation, etc.). It is apparent that at least some of these features, in particular the great size of head and very broad genae, are adaptive but, unfortunately, the mode of life of the new genus is still unknown to understand their real functional significance. The unique morphological features of the new genus and its locality suggest that this taxon may be an old relict. It is well known that south-western corner of Western Australia is one of the major centers of endemism of Australian fauna and flora with many old elements related to the temperate forms of South America, more rarely of South Africa (e. g. MARCHANT 1973, HOWDEN 1981, MAIN 1981). In this connection it should be interesting to compare in detail the new genus with the unknown to me in nature, monobasic genus *Nemaglossa* SOLIER, 1849 from Chile, which, according to BALL (in REICHARDT 1977: 424), also belongs to the notiobioid complex. This genus is dissimilar to other groups of Neotropical *Anisodactilina* and has been included in the subtribe *Pelmatelina* formerly. Some of its distinctive generic features listed by BALL (l. c.), in particular small size, very short metepisterna and reduced wings, are similar to those of the *Nornalupia* gen. n. Based on the original description (SOLIER 1849), *Nemaglossa* differs from the new genus at least in lesser head, broader paraglossae and impunctate dorsum.

Nornalupia megacephala sp. n.
(Figs 1–11)

Type material – Holotype, male, SW Australia, W Gully Rd., Nornalup-Walpole Nature Park, 25.I.1979, unknown collector (ANIC). Paratypes. 10 males, 9 females, same data as holotype.

Description – Body length in male 6.2–6.6 mm, in female 6.4–7.6 mm, width 2.4–2.6 and 2.6–2.9 mm, respectively.

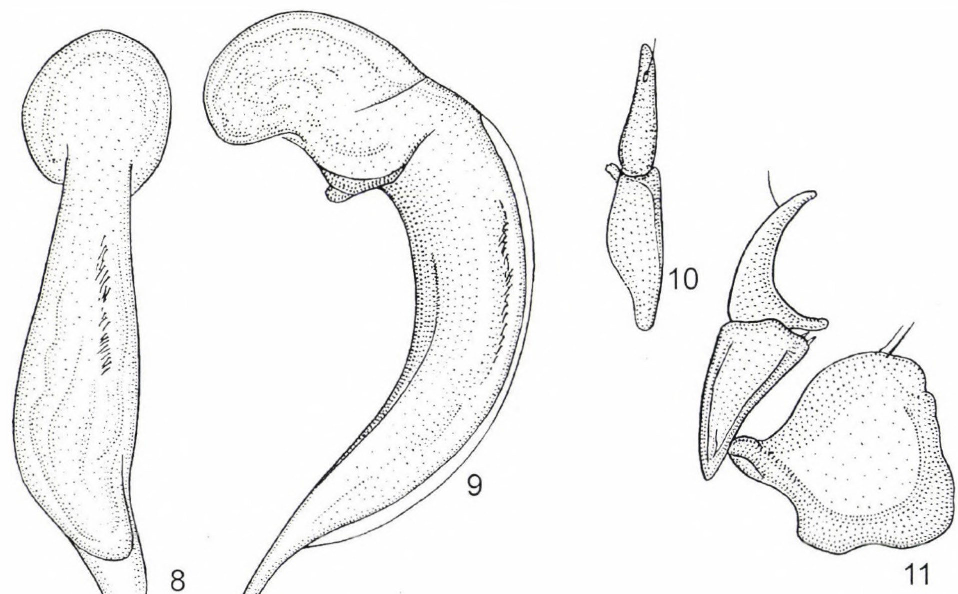
Body dark brown to almost black, with labrum, anterior margin of clypeus, narrow margins of pronotum and elytra usually reddish brown; palpi, antennae and legs brown, tibiae apically and femora more or less infuscated. Upperside shining, not iridescent and without metallic tinge.

Head, measured across eyes and across neck constriction, correspondingly 0.81–0.87 and 0.66–0.72 times as wide as pronotum in male, and 0.85–0.92 and 0.69–0.76 times as wide as pronotum in female. Antennae slender, with middle segments a little more than 1.5 times as long as wide, reaching only base of elytra. Dorsal punctation variable from very fine and restricted to lateral portions of head to somewhat coarse and distributed almost throughout. Dorsal microsculpture, ex-

cept for very narrow area under each eyes covered with fine isodiametric meshes, invisible even at high magnification.

Pronotum 1.40–1.54 times as wide as long, widest in anterior third just behind lateral setigerous pores, with sides rounded anteriorly and straightly or weakly sinuately covergent in posterior half (Figs 3–4). Anterior and posterior margins more or less straight, latter a little narrower than former and notably narrower than elytral base between humeal angles. Apical angles small and acute, weakly protruding, very narrowly rounded at tip. Basal angles obtusangular, more or less narrowly rounded at apex. Lateral furrowes narrow anteriorly and medially, weakly widened before basal angles and usually fused there with small and shallow basal foveae forming comparatively deep united laterobasal deppressions; lateral margins at basal angles slightly reflexed. Mediobasal portion of pronoum very convex. Punctures in laterobasal depressions most coarse and often confluent. Microsculpture invisible.

Elytra widest at middle, in male 1.40–1.44 times as long as wide, 2.32–2.43 times as long and 1.17–1.27 times as wide as pronotum; in female these indices 1.46–1.54, 2.58–2.71 and 1.19–1.28, respectively. Humeri prominent, sharp at apex, without denticles. Sutural angles acutangular, narrowly rounded at apex. Basal edge rather strongly sinuate laterally and meeting lateral margin in weakly obtuse or nearly right angle. Intervals strongly narrowed before apex. Striae somewhat thin. Marginal series consisting of 6 basal and 7 apical umbilicate pores. Microsculpture visible in female only on two lateral intervals throughout and usually also in narrow basal portion of all other intervals, consisting of fine and narrow transverse meshes, in male obliterate meshes visible sometimes only in apical portion of lateral intervals.



Figs 8–11. *Nornalupia megacephala* sp. n. Median lobe of aedeagus, dorsal (8) and lateral (9) aspects. Stylus, lateral aspect (10). Stylus and valvifer, ventral aspect (11). Scale: 0.5 mm

Wings completely reduced. Metepisterna (Fig. 6) small, hardly longer than wide, strongly narrowed posteriad. Metacoxae each only with two obligatory setigerous pores, without any additional pores.

Median lobe of aedeagus arcuate, with apical portion curved dorsad (lateral aspect) and to right; terminal lamella asymmetrical, longer than wide, moderately broad, narrowly rounded at apex, with sides roundly convergent apicad (dorsal aspect). Internal sac with dorso-lateral longitudinal chain of small spines.

Etymology. The species epithet is derived from the Greek, *megas* (big) and *cephale* (head), referring to the remarkable feature of the new species.

Distribution – Known only from the type locality, Nornalup-Walpole Nature Park, in the south-western corner of Western Australia.

*

Acknowledgements – I cordially thank Dr. OTTÓ MERKL and Dr. GYŐZŐ SZÉL (Hungarian Natural History Museum, Budapest) for providing hospitality during my visit to Budapest and Dr. MARTIN BAEHR (Zoologische Staatssamlung München) for the valuable remarks concerning the manuscript. The research was supported by the grant no. 01–04–49641 from Russian Foundation for Basic Research.

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NEW SPECIES OF SCAPHISOMA LEACH (COLEOPTERA: STAPHYLINIDAE: SCAPHIDIINAE) FROM MT. WILHELM, PAPUA NEW GUINEA

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Five new scaphidiines are described from Mt. Wilhelm, Papua New Guinea: *Scaphisoma coeruleum* sp. n., *S. fenestratum* sp. n., *S. infirmum* sp. n., *S. frontale* sp. n. and *S. medium* sp. n. *Metalloscapha* Löbl is placed in synonymy of *Scaphisoma*, and *Metalloscapha papua* Löbl is transferred to *Scaphisoma*.

Key words: Coleoptera, Staphylinidae, Scaphidiinae, New Guinea, systematics

INTRODUCTION

At present only 20 species of *Scaphisoma* LEACH are recorded from New Guinea (LÖBL 1975). That this number reflects rather inadequate knowledge than the diversity of the group is shown by the present study. A collection of *Scaphisoma* taken at high altitudes of the Mount Wilhelm, Papua New Guinea, consists of five species, all new to science. The aedeagal characters of these species indicate relationships to members of the *S. unicolor* group that is widely distributed in the Oriental realm but unknown from Australia, New Caledonia and Fiji. As in members of the *S. unicolor* the aedeagi are highly derived, with the basal bulb of the median lobe comparatively small, the apical process flattened and asymmetrical, the internal sac consisting of a membranous tube and a long flagellum that is free to large extend, and the parameres weakly sclerotized. The new species coming from the Mount Wilhelm may be distinguished from the Asian allied by the median lobe of the aedeagus lacking prominent articular process, the shape of the body that is weakly narrowed apically and comparatively parallel, the short metasternum and the large head. In addition, they share narrow subcoxal areas, elytra lacking basal striae, very fine punctation, and apical abdominal segments with punctulate microsculpture. Obviously they form a distinct species group. *Metalloscapha* LÖBL that is based on a single species, *M. papua* LÖBL, exhibits characters of the latter group. *Metalloscapha papua* was separated from the species-rich and widely distributed *Scaphisoma* LEACH mainly because of its conspicuously elongate 3rd antennal segments and the body shape. However, the length of the 3rd antennal segment and the shape of the body are more variable than former presumed. The study of large

collections of *Scaphisoma* yield species with comparatively elongate 3rd antennal segment, notably in *S. solutum* LÖBL from Thailand and *S. parasolutom* LÖBL from China (LÖBL 2000).

Acronyms used – HNHM: Hungarian Natural History Museum, Budapest; MHNG: Muséum d'histoire naturelle, Geneva.

SYSTEMATICS

Metalloscapha LÖBL, 1975 is junior subjective synonym of *Scaphisoma* LEACH, 1815, **syn .n.**

Metalloscapha papua LÖBL, 1975 is transferred to *Scaphisoma* LEACH, 1815, **comb. n.**

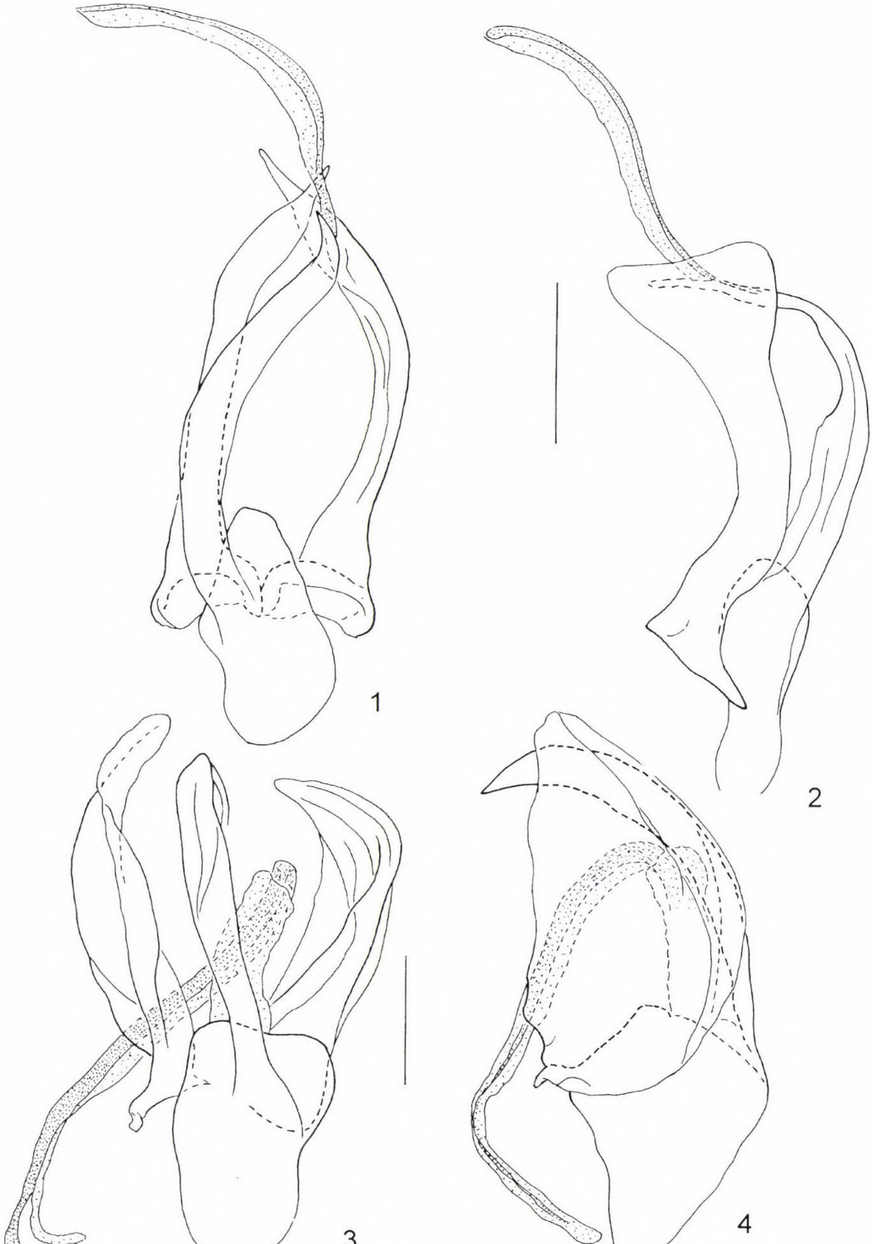
This species is known only from high altitudes of the Mt. Abilala, Finisterre Mts, Papua New Guinea. It may be distinguished from it congeners, the new species described below included, by the metallic shine of its body, the comparatively parallel body shape and the parameres of the aedeagus bearing each a large, membranous, apical lobe, in combination.

Scaphisoma coeruleum sp. n.
(Figs 1–2)

Holotype male, labelled: New Guinea /NE/ Mt. Wilhelm, Field Station, 16.IX.1968 /No. NG-M.R.25/ leg. Dr. I. Loksa (HNHM).

Paratypes with same data as holotype but: 3200 m, 14.IX. /No. NG-M.R. 20 and 21/, 2 males and 4 females (HNHM, MHNG); Mt. Wilhelm 3600 m, Iambuka Ridge, 18.IX.1968 /No. NG-M.R.29–31/ leg. I. Loksa, 2 females (HNHM, MHNG).

Description. Length 1.5 mm. Head, pronotum and most of elytra dark, with distinct blue or green metallic shine. Apices of elytra and of abdomen, and legs dark brown. Ventral side of thorax and most of abdomen black. Antennae ochreous, with apical segments darkened. Length ratio of antennal segments as: III 6, IV 8, V 11, VI 11, VII 14, VIII 10, IX 10, X 13, XI 17 (holotype); segment III comparatively wide, only 1.5 times as long as wide, segment IV almost 3 times as long as wide, narrower than segment III; segments V and VI each about as wide as segment IV, almost 4 times as long as wide; segment VII almost 3 times as long as wide, much wider than segment VI; segment VIII about 2.5 times as long as wide, segment XI about twice as long as wide. Eyes conspicuously large, covering lateral parts of head. Pronotum long, moderately narrowed anteriorly, with lateral contours oblique near base, slightly arcuate in anterior half. Lateral pronotal ridges not visible in dorsal view. Pronotal punctation dense, extremely fine and shallow. Pubescence very short but well visible. Scutellum completely covered by pronotal lobe. Elytra very weakly narrowed toward base, widest



Figs 1–4. Aedeagus of *Scaphisoma* species: *1–2* = *S. coeruleum* sp. n., scale bar = 0.1 mm; 3–4: *S. fenestratum* sp. n., scale bar 0.2 mm

posterior basal third, from widest point moderately narrowed toward apices. Lateral elytral contours slightly arcuate in apical half. Sutural margin not raised. Inner apical angle lying posterior level of outer apical angles; apical margins edentate, arcuate. Sutural striae fine, diverging from apices toward middle third of sutural length, parallel in anterior third of sutural length, ending posterior line of pronotal lobe, not curved laterally. Lateral margin ridge not visible at dorsal view. Lateral striae curved at base, not extending along basal margin. Punctation of elytra similar to that on pronotum. Metathoracic wings strongly reduced, present as filament-like rudiments. Ventral side of thorax lacking microsculpture and very finely punctate. Mesepimeral ridge slightly longer than interval to mesocoxa. Metasternum comparatively short, convex between mesocoxae, flattened between metacoxae, lacking impressions. Mesocoxal lines parallel to coxae, indistinctly punctate. Mesocoxal areas narrow, 0.02 mm long, about as long as one-third of shortest interval to metacoxae. Metepisterna wide apically, strongly narrowed anteriorly, with inner margin slightly arcuate, hardly impressed below plane of metasternum. Abdomen very finely punctate and with punctulate microsculpture, latter absent from 1st exposed sternite. Metacoxal lines parallel, 0.03 mm long, with distinct marginal punctures. Tibiae straight, slender.

Male sexual characters. Protarsi hardly widened. Aedeagus (Figs 1 & 2) 0.35–0.40 mm long. Median lobe with very long, sinuate apical process and basal bulb weakly sclerotized, prominent and narrowed apically. Apical process of median lobe strongly curved ventrally and very thin (lateral view), tapering at dorsal view. Parameres symmetrical, strongly widened apically. Internal sac with extruded part of flagellum very long.

Comments. *Scaphisoma coeruleum* resembles *S. papua* by its metallic shine of its body. These two species are the only known Scaphisomatini that have a metallic shine. The other scaphidiines with body having a metallic shine are members of the genus *Scaphidium* OLIVIER. *S. coeruleum* may be easily distinguished from *S. papua* by the blue pronotum and elytra, the shorter antennal segment 3 and the parameres comparatively longer, widened apically and lacking membranous lobes.

Scaphisoma fenestratum sp. n.
(Figs 3–4)

Holotype male, labelled: New Guinea /NE/ Mt. Wilhelm Field Stat. 3200 m, 14.IX.1968 /No. NG-M.R.21/ leg. Dr. I. Loksa (HNHM).

Paratypes: 1 male 4 females with same data as holotype (HNHM, MHNG), 1 female with same data but NG-M.R.20 (HNHM).

Description. Length 2.0–2.1 mm. Body dark brown to black. Elytra each with one small, round, ochreous spot situated posterior mid-length, in outer part of disc. Anterior margin of spots reaching elytral mid-length, posterior margin of spot reaching apical third of elytron; apical fourth of elytra ochreous. Apical abdominal segments lighter than most of body surface. Femora and tibiae reddish-brown or ochreous, antennae and tarsi ochreous. Length ratio of antennal segments as: III 6, IV 8, V 13, VI 13, VII 22, VIII 16, IX 18, X 17, XI 28; segment IV narrow, cylindrical, about 3 times as long as wide, narrower than segment III; segments V and VI subequal, each about 3 times as long as wide, distinctly wider than segment IV, segment VII moderately widened, about 4 times as long as wide, segment VIII comparatively narrow, 4 times as long as wide; segment XI oval, 3 times as long

as wide (holotype). Eyes conspicuously large, covering lateral parts of head. Pronotum moderately long, widest at base, strongly narrowed anteriorly, with lateral contours oblique near base, slightly arcuate in anterior half. Lateral pronotal ridges not visible in dorsal view. Pronotal punctation sparse, extremely fine and shallow. Tip of scutellum exposed. Elytra very weakly narrowed toward base, widest posterior basal fourth, from widest point moderately narrowed toward apices. Lateral elytral contours slightly arcuate in apical third, straight in middle third. Sutural margin raised in apical half to apical two-thirds. Inner apical angle posterior level of outer apical angles; apical margins edentate, arcuate. Sutural striae fairly deep, diverging from apices about up to mid-length, parallel in most of anterior half, extending anteriorly almost to or up to line of scutellar tip, not or shortly curved outwards, if curved not extending along basal margins of elytra. Lateral margin ridge visible in dorsal view; lateral striae curved at base, extending shortly along basal margin. Punctation of elytra similar to but slightly less fine than that of pronotum. Metathoracic wings strongly reduced, present as filament-like rudiments. Ventral side of thorax lacking microsculpture and very finely punctate. Mesepimeral ridge about as long as interval to mesocoxa. Metasternum comparatively short, very weakly convex in median part, lacking impressions. Mesocoxal lines parallel to coxae, indistinctly punctate. Mesocoxal areas narrow, 0.02–0.03 mm long, about as long as third of shortest interval to metacoxae. Metepisterna wide, moderately narrowed anteriorly, with inner margin straight, hardly impressed below plane of metasternum. Abdomen very finely punctate and with punctulate microsculpture, latter absent from 1st exposed sternite. Metacoxal lines parallel, 0.03 mm long, with distinct marginal punctures. Tibiae straight, slender.

Male sexual characters. Protarsi hardly widened. Aedeagus (Figs 3 & 4) 0.75 mm long. Median lobe with long, arcuate apical process (lateral view) and basal bulb weakly sclerotized, prominent and widened apically. Apical process strongly curved ventrally, about equally wide at dorsal and lateral views, tapering at lateral view. Parameres asymmetrical, strongly widened and weakly sclerotized. Internal sac with extruded part of flagellum very long.

Comments. This species resembles *S. papua* and *S. coeruleum* in most diagnostic characters but lacks metallic shine, has a characteristic small elytral spot, comparatively shorter 3rd antennal segment and larger body. The aedeagus of *S. fenestratum* differs conspicuously from that of its allied *S. frontale* except, by the very large, weakly sclerotized parameres.

Scaphisoma infirmum sp. n.
(Figs 5–6)

Holotype male, labelled: New Guinea /NE/ Mt. Wilhelm Field Station 16.IX.1968. /No. NG-M.R. 25/ leg. Dr. I. Loksa (HNHM).

Paratype female: New Guinea /NE/ Mt. Wilhelm Kambugomambuno 17.IX.1968. /No. NG-M.R. 26/ leg. Dr. I. Loksa (MHNG).

Description. Most external diagnostic characters as in *S. fenestratum*. It differs as follows: Length 1.8–2.0 mm. Body dark brown, elytra each with subapical, oblique ochreous fascia. Latter entire or interrupted at middle, extended almost to sutural stria and, outwards, almost touching lateral stria. Apices of elytra lighter than most of elytral disc. Apex of abdomen slightly lighter than remainder of body. Femora as dark as body, tibiae, tarsi and antennae lighter. Length ratio of antennal seg-

ments as: III 6, IV 10, V 17, VI 16, VII 20, VIII 14, IX 17, X 15, XI 20; segments IV, V and VI narrow, V and VI only hardly wider than segment IV, segment V almost 6 times as long as wide, segment VI well 5 times as long as wide; segment VII about 3 times as long as wide; segment VIII much wider than segment VI, about 3 times as long as wide; segment XI oval, about twice as long as wide. Elytral punctation slightly coarser than in *S. fenestratum*, coarser than pronotal punctation. Metathoracic wings well developed. Metasternum longer than in *S. fenestratum*. Mesocoxal areas 0.03 mm long, about as one fifth of shortest interval to metacoxae. Metacoxal lines subparallel.

Male sexual characters. Protarsal segments hardly widened. Aedeagus (Figs 5 & 6) 0.50 mm long. Apical process of median lobe similar to that in *S. fenestratum*, but basal bulb oval and parameres strongly asymmetrical. Left paramere strongly widened, right paramere narrow.

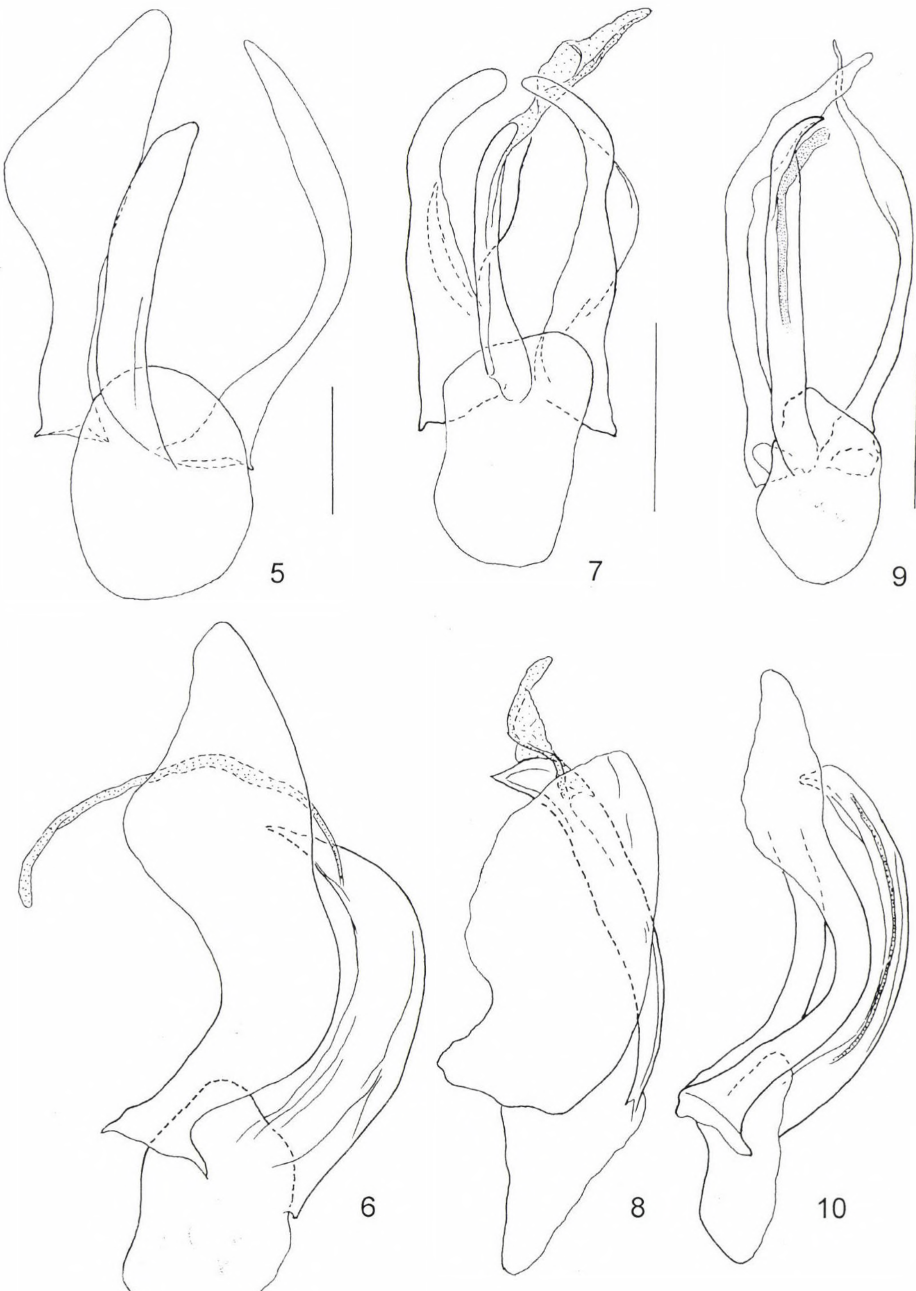
Scaphisoma frontale sp. n.
(Figs 7–8)

Holotype male labelled: New Guinea /NE/ Mt. Wilhelm 3600m Imbuka ridge 18.IX.1968 /No. NG-M.R.30/ leg. Dr. I. Loksa (HNHM).

Paratypes: same data as holotype, 1 male (MHNG); same data but No. NG-R. 31 leg. Dr. I. Loksa, 3 females (HNHM, MHNG); Mt. Wilhelm 4–9.VIII.1969 /No.NGMt-B39/ leg. Dr. J. Balogh, 1 male (MHNG).

Description. Length 1.55–1.65 mm. Body black or very dark reddish-brown, elytra dark brown along apices, apical abdominal segments, femora and tibiae redish-brown. Tarsi and antennae lighter than tibiae. Length ratio of antennal segments as: III 5, IV 6, V 10, VI 11 VII 16, VIII 12, IX 14, X 13, XI 16 (holotype); segment III cylidrical, narrow, slightly narrower than segment IV, segment V about as wide as segment III, segment VI thickened apically, slightly wider than segment V; segment VII much wider than segment VI, segments VII and VIII each about 3 times as wide as long, segment XI oval, broad, hardly twice as long as wide. Eyes not conspicuously large, not entirely covering lateral parts of head. Pronotum moderately long, strongly narrowed anteriorly, with lateral contours arcuate. Lateral pronotal ridges not visible in dorsal view, or exposed at middle. Pronotal punctation sparse, extremely fine and shallow. Exposed tip of scutellum minute. Elytra distinctly narrowed toward base, widest posterior basal fifth, from widest point moderately narrowed toward apical third of lateral length, distinctly narrowed in apical third. Lateral elytral contours arcuate in apical third, straight in middle third. Sutural margin raised in apical half to apical two-thirds. Inner apical angle of elytra situated posterior line of outer apical angles; apical margins edentate, arcuate. Sutural striae shallow, almost parallel, extending anteriorly almost to line of scutellar tip, slightly curved outwards. Punctation of elytra similar to that of pronotum although slightly less fine. Metathoracic wings almost completely atrophied. Ventral side of thorax lacking microsculpture and very finely punctate. Mesepimeral ridge shorter than interval to mesocoxa. Metasternum short, weakly convex in median part, lacking impressions. Mesocoxal lines parallel to coxae, indistinctly punctate. Mesocoxal areas narrow, 0.03 mm long, about as long as half of shortest interval to metacoxae. Metepisterna wide, strongly narrowed anteriorly, with inner margin almost straight, impressed below plane of metasternum. Abdomen very finely punctate and with punctulate microsculpture, latter absent from 1st exposed sternite. Metacoxal lines parallel, 0.03 mm long, with distinct marginal punctures. Tibiae straight, slender.

Male sexual characters. Frons with a large impression covered by a patch of adpressed, very dense, light pubescence. Protarsi weakly widened. Aedeagus (Figs 7 and 8) 0.54–0.55 mm long, sim-



Figs 5–10. Aedeagus of *Scaphisoma* species: *5–6* = *infirmum* sp. n., scale bar = 0.1 mm; 7–8 = *S. frontale* sp. n., scale bar = 0.2 mm; 9–10 = *S. medium* sp. n., scale bar = 0.2 mm

ilar to that in *S. fenestratum*. Apical process of median lobe strongly inflexed laterally and less curved ventrally.

Comments. The pubescent frontal impression in males in *S. frontale* is a unique feature within the scaphidiines. In addition, this species may be distinguished from its allied by the comparatively short fourth antennal segment, in combination with the colour patter of the body. The aedeagus is similar to that in *S. fenestratum* but the apical process of the median lobe is less curved in *S. frontale*. The aedeagal characters indicate close relationships to *S. fenetratum*. These two species can be easily distinguished by the elytral colour pattern.

Scaphisoma medium sp. n.
(Figs 9–10)

Holotype male labelled: New Guinea /NE/ Mt. Wilhelm 3600 m Imbuka Ridge 18.IX.1968 /No. NG-M.R.28/ leg. Dr. I. Loksa (HNHM).

Paratypes: Mt. Wilhelm 3200 m Field Station 14.IX.1968 /No. NG-M.R.20/ leg. Dr. I. Loksa 3 females (HNHM, MHNG;); same data but NG-M.R.22, 1 male, 1 female (HNHM, MHNG); same data but NG-M.R.23, 1 female (MHNG); same data but 16.IX.1968, NG-M.R.25, 1 female (HNHM); Mt. Wilhelm field Station, 20.IX.1968 /No. NG-M.R.32/ leg. Dr. I. Loksa 3 females (HNHM, MHNG); Mt. Wilhelm, 4000m, 15.IX.1968 /No. NG-M.R. 24/ leg. Dr. I. Loksa, 2 females (HNHM); Mt. Wilhelm, 3900m, 13–24.IX.1968 /No. NG-M-B. 106 and 132/ leg. Dr. J. Balogh 1 male, 1 female (MHNG).

Description. Length 1.60–1.95 mm. With most external diagnostic characters as *S. frontale* but the antennal segment 4 longer (the holotype with the length ratio of the antennal segments as: III 5, IV 8 V 14, VI 13, VII 17, VIII 12, IX 15, X 14, XI 18), the scutellum completely covered by the pronotal lobe, the metasternum flattened in the middle, the microsculpture on the abdominal sternites 2 to 4 indistinct, the frons in male not impressed and lacking setal patch, and the aedeagus very distinct. Metathoracic wings present as narrow rudiments reaching about up to abdominal base. Male lacking frontal impression and setose patch.

Aedeagus (Figs 9 and 10) 0.65–0.67 mm long. Median lobe with basal bulb asymmetrically narrowed apically, apical process arcuate, at tip curved. Parameres asymmetrical, narrow, arcuate (lateral view), widened in apical parts, right paramere wider than left paramere. Extruded part of flagellum long.

*

Acknowledgements – I thank my colleague Dr. OTTÓ MERKL, Hungarian Natural History Museum Budapest, for the loan of the material.

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Catalogue of Palaearctic Diptera

edited by Á. SOÓS and L. PAPP

Volume 13
Anthomyiidae – Tachinidae

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Volume 13 lists the names of 460 genera, 38 subgenera and 2389 species assigned to three families. Furthermore, 672 synonymous generic and 2477 specific names, 1807 emendations, errors, nomina dubia and doubtful genera and species are listed. The period of the Catalogue extends from 1758 to 31 December, 1982.

Contents: Explication to distribution. Type-species designations in Volume 13. New names proposed in Volume 13. Families: Anthomyiidae (Á. DELY-DRASKOVITS). Rhinophoridae (B. HERTING). Tachinidae (B. HERTING and Á. DELY-DRASKOVITS). Bibliography. Index.

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SPHAEROLIODES ACUMINATUS SP. N. (COLEOPTERA: LEIODIDAE, LEIODINAE) FROM TAIWAN AND NOTES ON TWO OTHER SPECIES

Z. ŠVEC

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Sphaerolides acuminatus sp. n. from Taiwan is described and distinguished from the others species of the genus. *Colenisia topali* DAFFNER, 1988 is recorded for the first time from Taiwan and *Zeadolopus ventriculus* ŠVEC, 1997 from Ghana.

Key words: taxonomy, Leiodidae, Leiodinae, *Sphaeroliodes*, *Colenisia*, *Zeadolopus*, Taiwan, Ghana

INTRODUCTION

Two species of the genus *Sphaeroliodes* PORTEVIN, 1905 were known up to now (PORTEVIN 1905, PERKOVSKY 1988). Both species seem to occur very rarely. Only the type series is known of *S. erlan* PERKOVSKY, 1988; the other species, *S. rufescens* PORTEVIN, 1905 was recorded only four times since the year of the original description (PORTEVIN 1914, 1927, HLISNIKOVSKÝ 1963, PERKOVSKY 1988).

Colenisia of the Palaearctic region was studied by DAFFNER (1988), HOSHINA (1999) and ŠVEC (1994). Only two Palaearctic species occurring in continental China and Taiwan were described under the genus until now.

African *Zeadolopus* were recently reviewed by ŠVEC (1997). Altogether four species including one species of doubtful taxonomic placement are known from Africa.

MATERIAL

The leiodid material from the collection of the Hungarian Natural History Museum, Budapest (HNHM) was studied. Two specimens of an unknown *Sphaeroliodes* that were discovered among the material were compared to three specimens of *S. rufescens* preserved in the collection of the National Museum, Prague (NMP). HLISNIKOVSKÝ (1963) designated one of them as allotypus and the others as paratypes, although the specimens did not belong to the type series. In fact the original description was based on a single female only. For the identification of the other species mentioned in this paper, the type and other material are preserved in the author's collection.

TAXONOMIC PART

Sphaeroliodes acuminatus sp. n.
(Figs 1–4)

Type material – Holotype, male, "Taiwan, Nantou Pr., Hoshuanshan Exp. Stat., 24°09'N, 121°17'E, from bark at night, 3100 m, 27.ix.1999, G. Csorba & B. Herczig", HNHM; paratype, male, the same, SC.

Description – Length of body 4.8–5.1 mm, in holotype 4.8 mm, head 1.0 mm, pronotum 1.3 mm, elytra 2.5 mm, antenna 1.6 mm, maximum width of head 1.6 mm, pronotum 2.9 mm, elytra 2.8 mm.

Broadly oval (Fig. 1); reddish-brown with pronotal lateral margins widely and basal margin narrowly reddish; underside reddish with yellow-brown mesosternum and light chestnut metasternum. Mouth parts and antennae up to segment 6 reddish-brown; antennal segments 7–11 infuscate. Dorsum partly, venter entirely microsculptured.

Head. Convergent anteriorly in dorsal view; widest at broadly rounded temporal angles. Temples very long; length ratio of eye : temple = 1.4. Clypeal line very fine and unobtrusive. Puncturation fine, punctures separated by about 4–8 times their own diameter; each puncture furnished by single short fine pale, forward directed, seta. Two large frontal punctures located near each eye medially. Traces of microsculpture on front near eyes. Antennae (Fig. 4) with very long and slim segment 3. Length ratio of antennal segments 2–11: 1.0 – 3.0 – 1.0 – 1.0 – 0.8 – 0.9 – 0.9 – 1.3 – 1.3 – 2.5. Ratio of length : width of antennal segments 2–11: 1.3 – 3.5 – 1.2 – 1.1 – 0.8 – 0.8 – 0.8 – 1.0 – 1.0 – 2.1. Width ratio of club segments: 1.0 – 0.9 – 1.2 – 1.2 – 1.1.

Pronotum. Widest at base. Basal margin curved forward laterally to posterior angles; those very broadly rounded in dorsal and lateral view. Pronotum very finely bordered from lateral sixth of basal length to anterior angles. Median part of pronotal base and anterior margin simple. Punctures larger than those on head; separated by 4–6 times their own diameter, each puncture furnished by single short fine pale, backward directed, seta. One large shallow puncture at each side of disc. Interstices with microreticulation increasing in strength laterally and basally; anteriorly weakly developed, superficial.

Scutellum. Smooth.

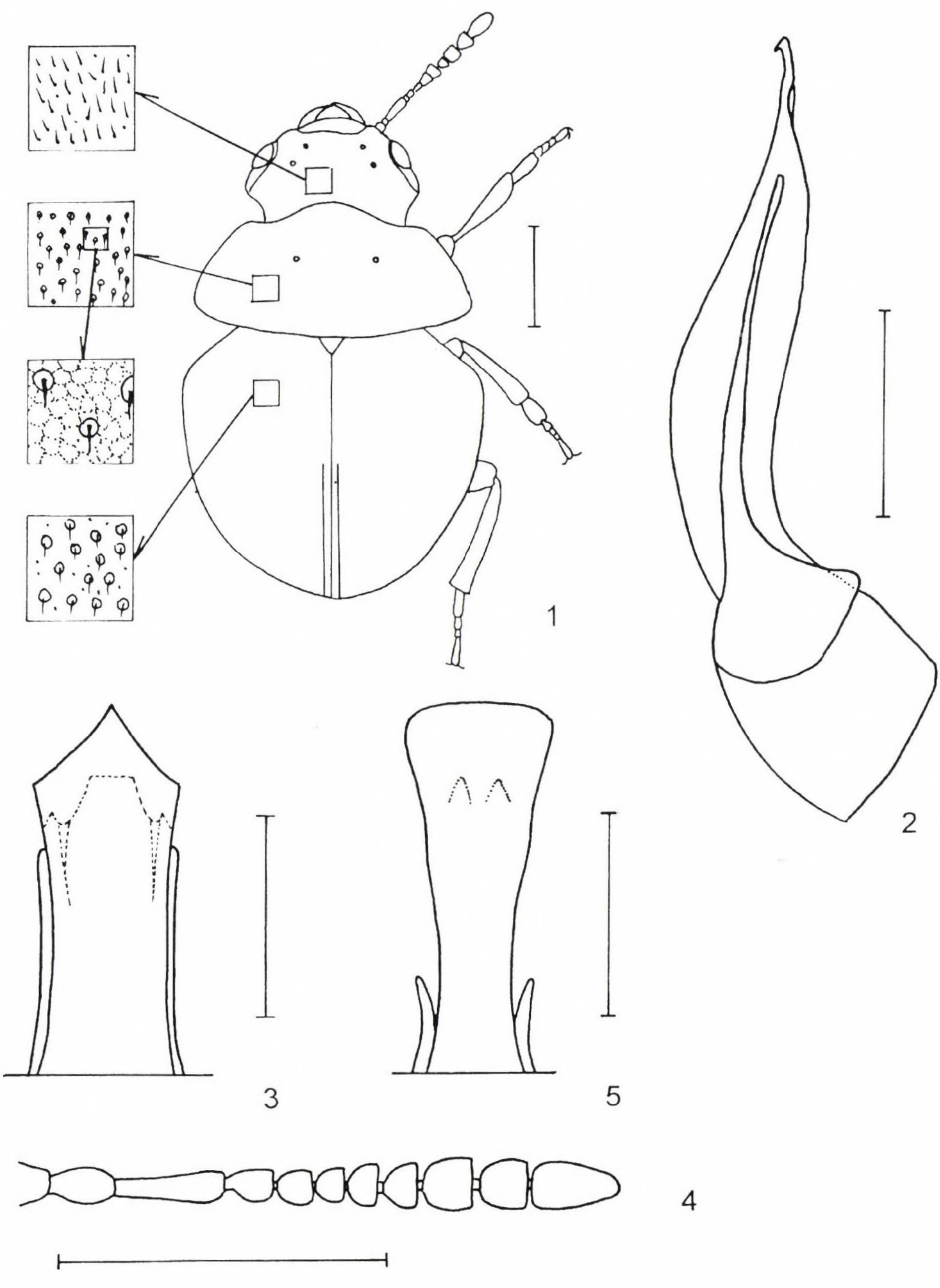
Elytra. Broadest at broadly rounded shoulders. Distinctly punctured; punctures inordinate, large shallow, separated by 1–2 times their own diameter. Interstices with traces of irregular transverse discontinuing wrinkles. Some minute scarce punctures interposed. Sutural stria feebly impressed reaching half of elytral length. Lateral margins feebly margined. Epipleurae feebly transversely wrinkled.

Legs. Tarsal segment 1 on anterior and middle legs strikingly dilated, broader than tibia distally; segment 2 feebly dilated.

Genitalia. Aedeagus as in Figs 2–3. Female unknown.

Variation. Head lacking microsculpture; pronotum anteriorly and on disc with traces, posteriorly and laterally with well-developed microreticulation in paratype.

Diagnosis. *Sphaeroliodes acuminatus* sp. n. differs from both other species of the genus by antennal segment 3, being three times longer than segment 2, while segment 3 is at most 1.5 times as long as segment 2 in both species compared. Also aedeagus shows specific characters.



Figs 1–5. 1–4: *Sphaeroliodes acuminatus* sp. n.: 1 = body outline, 2 = aedeagus laterally, 2 = anterior tarsus, 3 = tip of aedeagus dorsally, 4 = antenna. 5: *S. rufescens* PORTEVIN, 1905, tip of aedeagus dorsally

DISCUSSION

PERKOVSKY (1988) in the key to the identification distinguished *Sphaeroliodes erlan* from *S. rufescens* by their colour and presence of microsculpture and by width-to-length ratio of antennal segments 9 and 10. According to the original description *S. erlan* has reddish head and pronotum lacking microsculpture, while microsculpture is present on dark brown head and pronotum in *S. rufescens*. Presence and strength of microsculpture are variable in *S. acuminatus*. PERKOVSKY (1988) supposed antennal segments 9 and 10 to be quadrate while width-to-length ratio is 1.3–1.4 in *S. erlan*. In fact the same ratio is 1.3 (segment 9) and 1.2 (segment 10) in specimen of *S. rufescens* labelled as allotypus. The shape of aedeagus (judging from the drawing given by PERKOVSKY 1988, figs 4–5) is extremely similar, without obvious differences, in *S. erlan* and *S. rufescens*. It seems that the matter requests further studies.

Taking into account all that is mentioned above, all species of the genus could be distinguished as follows:

1 Tip of aedeagus truncate with rounded edges (Fig. 5). Antennal segment 3 at most 1.5 times as long as segment 2 — 2

– Tip of aedeagus triangular (Fig. 3). Antennal segment about 3 times as long as segment 2. Length 4.8–5.1 mm. Taiwan — *S. acuminatus* sp. n.

2 Head and pronotum dark brown; microsculptured. Length 3.8–4.5 mm. Japan, Kuril Isl. — *S. rufescens* PORTEVIN, 1905

– Head and pronotum reddish; without microsculpture. Length 4.5 mm. Russian Far East — *S. erlan* PERKOVSKY, 1988

Colenisia topali DAFFNER, 1988

Material examined – 2 males, Taiwan, Nantou Prov., Huisun Forest Area, 15 km N of Puli, 500 m, under bark, 12–13.4.1997, G. Csorba & L. Ronkay, HNHM, SC.

Distribution: Vietnam, Taiwan. New for Taiwan.

Zeadolopus ventriculus ŠVEC, 1997

Material examined – 2 males, 2 females, Ghana, Ashanti, Kumasi, 330 m, N 6.43 – W 1.36, light trap, no 225, 12.vi.1967, leg. Endrődy-Younga, 1 male, same but 16.vi.1967, light trap, no 226; 4 specimens, HNHM, 1 specimen, SC.

Distribution: Ethiopia, Ghana. New for Ghana.

*

Acknowledgements – I wish to thank Dr. JOSEF JELÍNEK (NMP, Prague, Czech Republic) and Dr. OTTÓ MERKL (HNHM, Budapest, Hungary) for making the material preserved in NMP and HNHM available for study. My thanks are also due to my friend JONATHAN COOTER (Hereford, England) for reading the manuscript.

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Checklist of the Diptera of Hungary

Edited by L. Papp

This is an international undertaking of 20 authors: a checklist of the dipterous species found through the end of 2000 in Hungary, with references to their first reliable records in the territory of modern Hungary. The "minimum requirements" for a "first record" are to have the name of the identifier and the place of deposition, and to have evidence that the site is a locality of present-day Hungary. The starting point for most parts is Thalhammer's Fauna Regni Hungariae in 1900 and every family part has a short introduction. These parts contain data on the number of recorded species and on the number of species expected to occur in Hungary. Most of the voucher specimens are deposited in the Diptera collection of the Department of Zoology, Hungarian Natural History Museum, Budapest (HNHM); in exceptional cases the name of the relevant institution is given. There are numerous species new to Hungary reported here for the first time, however, the dipterous fauna of Hungary is still poorly known with 5550 species in this book. According to our present knowledge no less than 10000 species may occur in the country.

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MALAYOSCELIS GEN. N., THE THIRD GENUS OF THE PYCNOCERINI (COLEOPTERA: TENEBRIONIDAE) FROM THE ORIENTAL REGION*

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Malayoscelis gebieni gen. et sp. n. (Coleoptera: Tenebrionidae, Lagriinae) from Malaysia (Cameron Highlands) is described.

Key words: Coleoptera, Tenebrionidae, Lagriinae, Pycnocerini, *Malayoscelis* gen. n., new species, Malaysia, Cameron Highlands

INTRODUCTION

The Pycnocerini are a group of tenebrionids occurring specially in tropical Africa, the exception being *Pheugonius* FAIRMAIRE, 1899 (3 species, see FERRER & MORAGUES 2000) and *Aediotorix* BATES, 1868 (? 4 species) in the Oriental region (Philippines, Indonesia, Malaysia) (for distribution see Fig. 11). Adult Pycnocerini are usually of bigger body size (up to 50–60 mm) and possess, among other characters (see GEBIEN 1904), strikingly modified legs with armed femora. The Pycnocerini are placed within the subfamily Lagriinae and are divided into 2 subtribes (Chiroscelina with bifid, Pycnocerina with truncate mandibles) (WATT 1974).

For a few years a series of a bigger tenebrionid is known from the Cameron Highlands (Malaysia), which my colleagues (listed below in the Abbreviations) and me were unable to identify. After a detailed study it proved to be a new genus and new species of the Pycnocerini, which is described hereunder.

Abbreviations: CHBM – Collection BREMER, Melle/Germany (Prof. Dr. HANS J. BREMER); CSBC – Collection Bečvář, České Budějovice/Czech Republic (STANISLAV BEČVÁŘ); HNHM – Hungarian Natural History Museum, Budapest/Hungary (Dr. OTTÓ MERKL); SMNS – Staatliches Museum für Naturkunde, Stuttgart/Germany (author).

* Contributions to Tenebrionidae no. 42. For no. 41 see: *Ent. Blätter* **98**, 2002.

TAXONOMY

Malayoscelis gen. n.

Diagnosis: With all characters of the tribe Pycnocerini (see GEBIEN 1904) and subtribe Chiroscelina (WATT 1974). Head with clypeal suture distinctly impressed; temples considerably broadened. Antennae with prolonged antennomere 3. Both mandibles bifid. Maxillary palps with broadened last segment. Pronotum 1.3 times wider than long, with distinctly crenulate lateral margin. Elytra only with traces of 5–7 keels, without distinct rows of punctures; epipleura regularly narrowed towards apex without abrupt constriction, impunctate. Abdominal ventrites impunctate. Surface of all legs nearly impunctate and shining, femora in both sexes with distinct apical teeth, anterior tibiae bent in males, anterior and middle tibiae in males with distinctly hooked inner apex; apex of tibiae without spurs and with comb-like setae.

Type species: *Malayoscelis gebieni* sp. n. by monotypy and present designation.

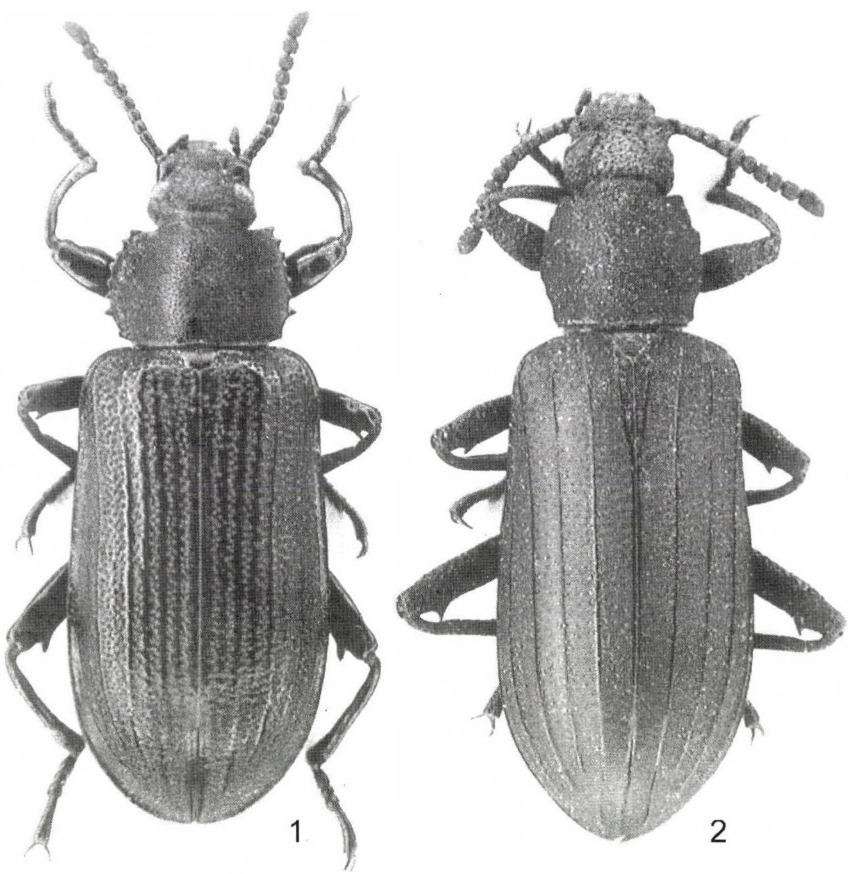
Discussion: *Malayoscelis* gen. n. (Fig. 1) shares with the other Oriental genus *Aediotorix* BATES, 1868 (syn. *Sipirocus* FAIRMAIRE, 1896) (Fig. 2) the following characters: head with impressed clypeal suture and with distinctly broadened temples, antennae with a prolonged antennomere 3, mandibles bifid, pronotum with crenulate lateral margin, apex of tibiae without spurs and with comb-like setae, and a similar body length of about 15–20 mm. The congeners of *Aediotorix* form a different monophyletic group (however, species characters are still unclear). *Aediotorix* is separated from *Malayoscelis* by a narrow pronotum (subquadrate or longer than wide), weak crenulation of the lateral margin, elytra with 4 distinct and complete keels besides distinct scutellar keel, scutellum with rough punctation, epipleura with a longitudinal row of distinct punctures, abdominal ventrites with partly coarse punctation, legs with coarse punctation and dull surface, and by different modifications of the legs.

The third genus from the Oriental region, *Pheugonius* FAIRMAIRE, 1899, obviously belongs to an other evolutionary group (together with the African genus *Prioscelis* HOPE, 1840) because of the following characters: antennae relatively short with antennomere 3 not prolonged, lateral margin of pronotum smooth, elytra with 9 distinct punctural rows and flat intervals without any keels, and different modifications of the legs besides the huge body size of 50–60 mm.

Malayoscelis gebieni sp. n.
(Figs 1, 3–10)

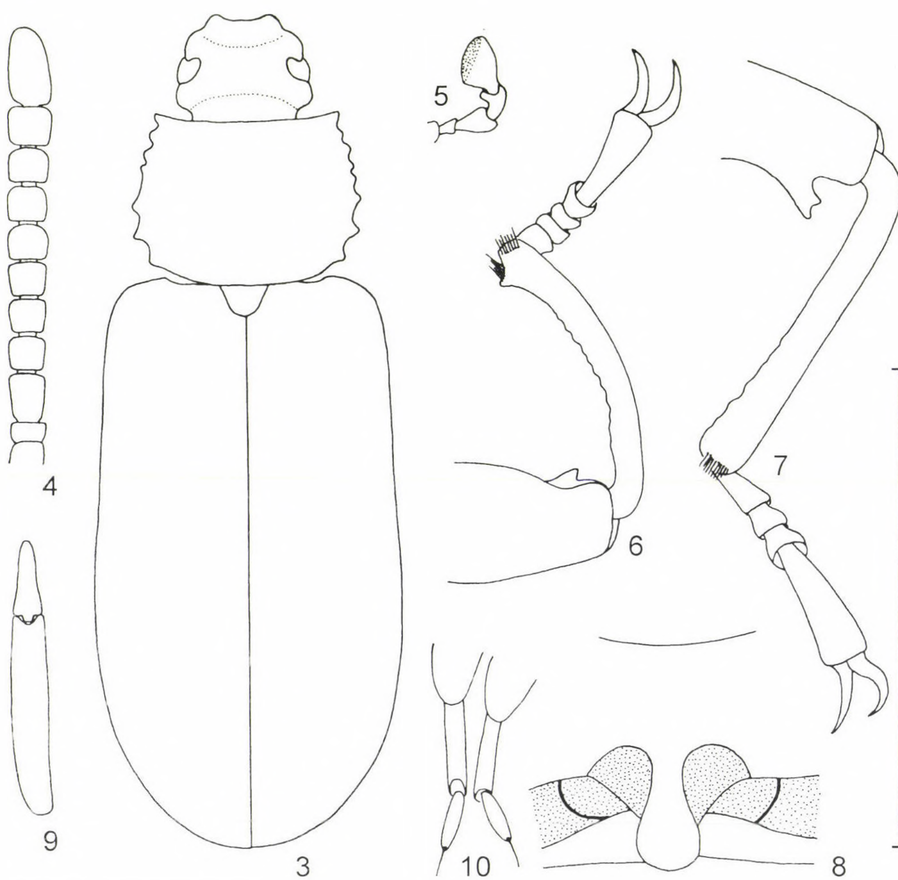
Holotype (male): Malaysia, Cameron Highlands, Tanah Rata, 13.–16.III.1997 leg. I. JENIŠ, CHBM.

Paratypes: Same data as holotype, 2 ex. CHBM, 2 ex. SMNS. – Malaysia, Cameron Highlands, Tanah Rata, 13.–17.II.1997 leg. U. DULÍK, 1 ex. CHBM. – Malaysia, Cameron Highlands, Brinchang, Gunung Beremban, 1600 m, 18.–19.I.1995 leg. S. & S. BEČVÁŘ, 2 ex. CSBC, 1 ex. SMNS. – Malaysia, Cameron Highlands, Gunung Jasar, 1400–1500 m, 20.–25.I.1995 leg. S. & S. BEČVÁŘ, 4 ex. CSBC. – Malaysia, Cameron Highlands, Tanah Rata, Gunung Jasar, 19.–25.VI.1995 leg. S. BEČVÁŘ, 1 ex. HNHM, 1 ex. CSBC. – Malaysia, Cameron Highlands, Tanah Rata, Gunung Jasar, 12.–15.II.1998 leg. S. BEČVÁŘ, 4 ex. CSBC, 1 ex. SMNS. – Malaysia, Cameron Highlands, Tanah Rata, 50 km SE Ipoh, 1500 m, 13.–16.III.1998 leg. M. JUST, 1 ex. CSBC.



Figs 1–2. Dorsal view. 1: *Malayoscelis* gen. n. *gebieni* sp. n. (Malaysia); 2: *Aediotorix* cf. *petersi* GEBIEN, 1921 (Philippines)

Description (male): Body length 16.0–17.5 mm. Body and appendages unicoloured dark brown to black, elytra sometimes indistinctly paler; surface of head and pronotum dull, of elytra somewhat shining; without regular setation. Head (Fig. 3) with coarse, confluent punctation; genae above antennal insertion without punctation and shining; clypeal suture distinctly impressed; clypeus excavated; temples considerably broadened and separated from the narrow neck; proportions of antennomeres see Fig. 4, antennomere 2 short, antennomere 3 prolonged, antennomeres 4–10 subquadrate, antennomere 11 twice as long as antennomere 10; both mandibles bifid; maxillary palps (Fig. 5) with broadened last segment; mentum pentagonal with an impression on each side and with a weak longitudinal keel medially; underside of head with rounded gular impression. Pronotum (Figs 1, 3) 1.3 times wider than medially long, with coarse and confluent punctation as on head, surface somewhat uneven; all margins bordered and shining, lateral margin distinctly crenulate; propleures with punctation sparser than on disc. Prosternum (Fig. 8) with a rounded, flat prosternal process not



Figs 3–10. *Malayoscelis* gen. n. *gebieni* sp. n. 3: dorsal view; 4: antenna; 5: maxillary palp; 6: anterior leg of male; 7: posterior leg of male; 8: prosternal process; 9: aedeagus; 10: gonostyles and last coxite lobes of female. Scale line: 10.0 mm (3), 5.0 mm (4–10)

distinctly surpassing posterior margin. Mesoventrite with dull and confluent punctation. Metaventrite medially impunctate and shining, with a distinct longitudinal line medially. Scutellum only with fine and separate punctures. Elytra (Figs 1, 3) long and parallel-sided; with traces of 5–7 keels, these keels shining, between the keels with shallow and confluent punctation, surface with additional microgranules; epipleura regularly narrowed toward apex, without separated constriction, shining and without punctures but with microgranules in the humeral part. Wings fully developed. Abdominal ventrites unpunctured, but with leather-like microstructure, last visible ventrite unbordered and without distinct modifications. Legs (Figs 6–7) with the anterior and middle femora with a single, posterior femora with 2 distinct teeth shortly before apex; anterior tibia bent, posterior tibia straight; all tibiae with crenulate inner side; anterior and middle tibiae with distinctly hooked inner apex; apex of tibiae without spurs and with comb-like setae; tarsal segments not dilated in males; claw segment of all legs longer than basal segments combined; trochanter of all legs without spines or other peculiarities; surface of all legs nearly impunctate and shining. Aedeagus (Fig. 9) quite small in comparison with the body length, connate parameres finger-like.

Sexual dimorphism: Not striking. Females also with armed femora, but anterior tibia somewhat straighter, anterior and middle tibia without hooked inner apex.

Etymology: This taxon is named in honour of HANS GEBIEN (1874–1947), whose monograph of the Pycnocerini (1904) was the first of his numerous and substantial contributions towards tenebrionid taxonomy.

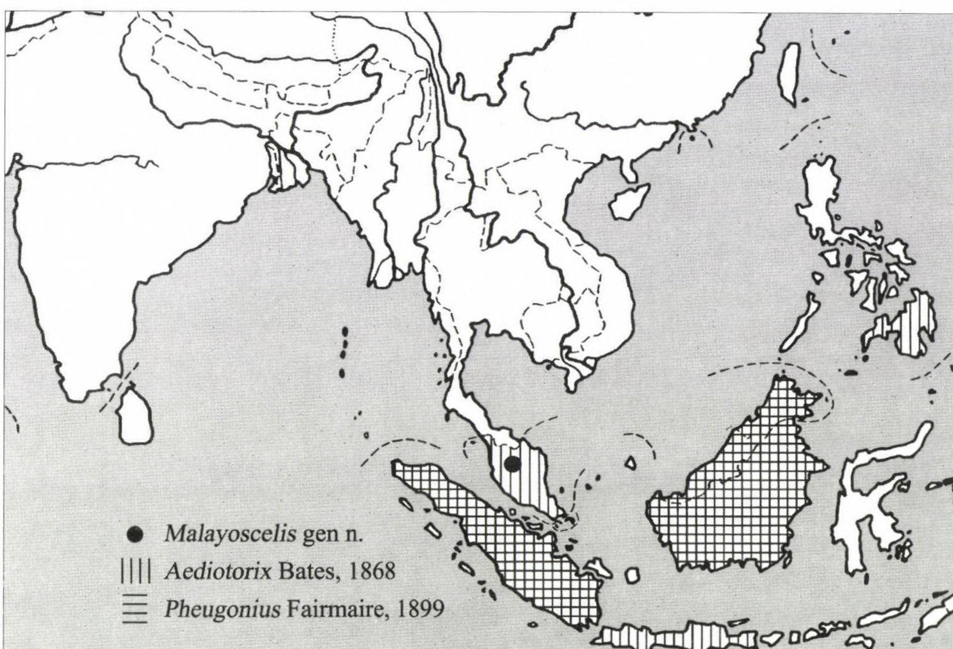


Fig. 11. Distribution of the known genera of the Oriental Pycnocerini

Biology: Adult beetles were collected in standing trunks of dead broadleaved trees, together with larvae and pupae. The rotten, white coloured substrate was said to be extremely dry. A species of *Aediotorix* was found syntopically (BEČVÁŘ, personal communication).

NEW AND COMPARED MATERIAL OF AEDIOTORIX BATES, 1868

The species identification within the genus is unclear, although only a few taxa have been described. However, most descriptions are based on single males or females without considering sexual dimorphism.

Aediotorix cf. *jansoni* BATES, 1868: Malaysia, Perak, 25 km NE Ipoh, Banjaran Titi Wangsa Mts., Mt. Korbu, 1200 m, 27.I.–2.II.1999 leg. P. CECHOVSKÝ, 1 ex. SMNS.

Aediotorix cf. *kolbei* GEBIEN, 1904: Borneo, Sabah, Kinabalu NP, Headquarters, 1500–1600 m, 11.–15.XI.1996 leg. W. SCHAWALLER, 1 ex. SMNS.

Aediotorix cf. *petersi* GEBIEN, 1921 (Fig. 2): Philippines, Mindanao, 25 km NW Zamboanga, camp Susana, 800 m, 28.–30.IV.1996 leg. L. BOLM, 1 ex. SMNS. – Philippines, Mindanao, Mt. Apo, Ilomavis, 1400 m, 18.–19.V.1996 leg. L. BOLM, 2 ex. SMNS.

*

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A REVIEW OF THE PALAEARCTIC SPECIES OF THE LEPTOMORPHUS QUADRIMACULATUS (MATSUMURA) GROUP (DIPTERA: MYCETOPHILIDAE)

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Four species of the *Leptomorphus quadrimaculatus* species group were recognized. *Leptomorphus quadrimaculatus* (MATSUMURA, 1916) is known from Japan and the Russian Far East, *L. forcipatus* LANDROCK, 1918 sp. restit. from Central Europe, *L. subforcipatus* sp. n. from Russia and Finland, and *L. talyshensis* sp. n. from Azerbaijan.

Key words: Sciaroidea, Mycetophilidae, *Leptomorphus*, taxonomy, new species, lectotype designation, review

INTRODUCTION

The genus *Leptomorphus* CURTIS, 1831 comprises 27 described species of relatively large and brightly coloured fungus gnats (Diptera: Mycetophilidae). In the Catalogue of the Palaearctic Diptera (MATILE 1988), four species of *Leptomorphus* belonging to two subgenera are listed, one Eastern-Palaearctic species in the subgenus *Diomonus* Walker, 1848 and three species (2 European and 1 Japanese) from *Leptomorphus* s. str. Of the two European species, *L. (L.) walkeri* CURTIS, 1831 is relatively common and widely distributed, while the second, *L. (L.) quadrimaculatus* (MATSUMURA, 1916), is rather rare and little known.

We have recently recognized that our material of "*L. quadrimaculatus*" consists of several closely related species, separable on coloration and details of the male terminalia. The study of the type and other Central-European material of *Leptomorphus forcipatus* LANDROCK, 1918, hitherto considered as a synonym of *L. quadrimaculatus*, revealed that this species is valid and different not only from the true *quadrimaculatus*, but also from two other similar species, one from European Russia and the second from Azerbaijan.

All the species recognized within the *quadrimaculatus* species group are described below and their male and female terminalia figured.

MATERIAL AND METHODS

Altogether 39 specimens (both dried and stored in ethanol) from institutional and private collections have been examined. Male and female terminalia were macerated and cleared in 10 per cent potassium hydroxide, neutralized in acetic acid and placed in a pinned microvial filled with glycerol, or were left in ethanol. The terminology principally follows SÖLI (1997).

Collections examined: IEE – A. N. Severtsov Institute of Ecology and Evolution, Moscow, Russia; MMB – Moravian Museum, Brno, Czech Republic; JŠ – Collection of JAN ŠEVČÍK, Ostrava, Czech Republic; PCH – Collection of PETER CHANDLER, Melksham, United Kingdom.

SURVEY OF THE PALAEARCTIC SPECIES OF THE L. QUADRIMACULATUS GROUP

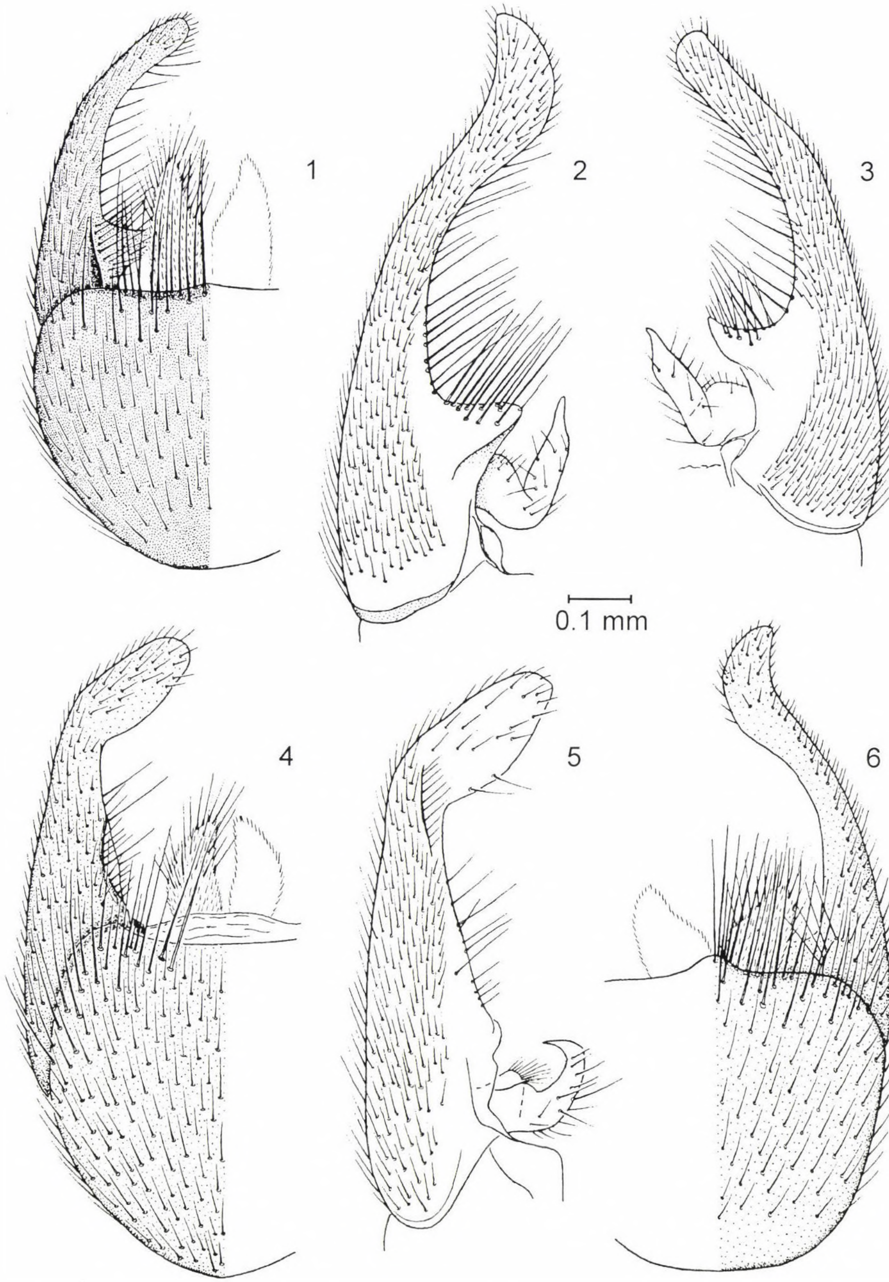
Leptomorphus forcipatus LANDROCK, 1918 **sp. restit.** (Figs 7, 10, 15–18)

Leptomorphus forcipatus LANDROCK, 1918: 107 (as var. of *walkeri* CURTIS, 1831).

Type material examined. Lectotype (herewith designated) ♂, labelled: "Árvaváralja" (= Slovakia, Oravský Podzámok, District Dolný Kubín), "Kertész", "24.vi.1914" (reverse of the same label), "Collectio K. Landrock, K Cziżek, D. Jacentkovský" (MMB). The lectotype is designated to elucidate the identity and fix the status of this species.

Other material examined. Czech Republic, Bohemia, Šumava Mts., Rokytská slať, peat-bog, 16.6.–21.7.1999, 1 ♂, M. Barták & Š. Kubík leg., Malaise trap (JŠ); Moravia & Silesia, Hrubý Jeseník Mts, Vrbno pod Pradědem env., Jelení Bučina Nature Reserve, maple-beech forest, 21.7.–24.9.1998, 1 ♂, yellow dishes filled with ethylene glycol (JŠ); Podyjí National Park, Horní Břečkov, 27.5.–7.6.2001, 1 ♂, M. Barták & Š. Kubík leg., Malaise trap (JŠ); Suchdol nad Odrou, Suchdolský les forest, 24.7.2002, 1 ♂, ex larva, collected on the lower side of *Stereum subtomentosum* (JŠ); Šilheřovice, Černý les Nature Reserve, beech forest, 1.–16.6.1998, 2 ♂♂, yellow dishes filled with ethylene glycol (JŠ, IEE). Poland, Cisna, 19.9.1991, 1 ♂, A. E. Stubbs leg. (PCH). Slovakia, Bukovské vrchy Mts, Nová Sedlica, 24.8.2001 (ex 26.8.2001), 1 ♂ 1 ♀ in copula, reared from pupae collected on the lower side of *Stereum hirsutum* (JŠ); Bukovské vrchy Mts, Uličské Krivé, Rožok National Nature Reserve, virgin beech forest, 23.8.–14.10.2001, 1 ♂, yellow dishes filled with ethylene glycol (JŠ).

Description. Male. Head mostly brown, clypeus light brown with long pale setae, palpus yellow. Antenna: flagellum dark brown, scapus yellow, pedicel brownish yellow, sixth flagellomere twice as long as broad. Thorax two-coloured, mesonotum with three dark brown wide longitudinal stripes, front corners, lateral and hind margins of mesonotum yellow, with dark oval spot above base of wing. Scutellum yellowish, dorsocaudally brown. Mediotergite yellow with brown medial posterior area. Laterotergite and preepisternum 2 yellowish, with ventral margin brown. Wing length 7.6 – 7.8 mm, wing with dark central spot, extending from Sc to stem of M fork, preapical band extending back to wing margin, clouds present also between branches of Cu fork and behind Cu2, stem of M fork 3 times as long as rm, base of Cu fork before base of r-m. Halteres yellow with brown knobs. Legs yellowish, first tarsomere 1.7 times as long as fore tibia, fore tibia with 9–10 a, 4–6 d, 5 pd, 7–8 p, 5–9 pv,



Figs 1–6. *Leptomorphus* WALK.: 1, 3 – *L. quadrimaculatus* (Russia, Lazo); 2, 6 – *L. subforcipatus* sp. n. (holotype); 4, 5 – *L. talyshensis* sp. n. (holotype): 1, 4, 6 = male terminalia (dorsal view); 2, 3, 5 = gonostylus (ventral view)

numerous v, arranged in 2 irregular rows; mid tibia with 9–12 a, 6 d, 7–11 pd, 9–10 p, 3–5 pv, 4–7 v; hind tibia with 9–14 a, 11–13 d, 12–13 pd, 11–12 p, 7 v, 4–7 av. Abdomen brownish yellow, apically darker. Tergites 1 to 6 brownish yellow, T2 basally brown, T6 caudally brown, T7 dark brown.

Terminalia yellow (Figs 7, 10, 15, 16).

Female. Similar to male in coloration. Terminalia yellow (Figs 17, 18).

Distribution. This species is reliably known only from the Czech Republic, Slovakia and Poland. At present, there is no voucher specimen of *L. forcipatus* from Hungary (MATILE 1988, erroneously recorded by PAPP & ŠEVČÍK 2001) and the records (both as *L. quadrimaculatus*) from Switzerland (CHANDLER 1998) and Russian Karelia (POLEVOI 2001) should be verified.

Biology. Larva found on the lower side of the fruit body of *Stereum hirsutum* and *S. subtomentosum*, where also pupation takes place. The mating was observed immediately after emerging from pupa and lasted several hours (in the laboratory conditions).

Remarks. *L. forcipatus* is close to *L. subforcipatus* sp. n., from which it differs in the shape of gonostylus. We prefer to designate the specimen from LANDROCK's collection as a lectotype, because LANDROCK (1918) did not state the number of specimens examined. The lectotype male is from northeastern Slovakia, not Hungary as considered by previous authors. The lectotype differs slightly from the other specimens, mainly in the shape of caudal margin of T9, but it is probably only intraspecific variability.

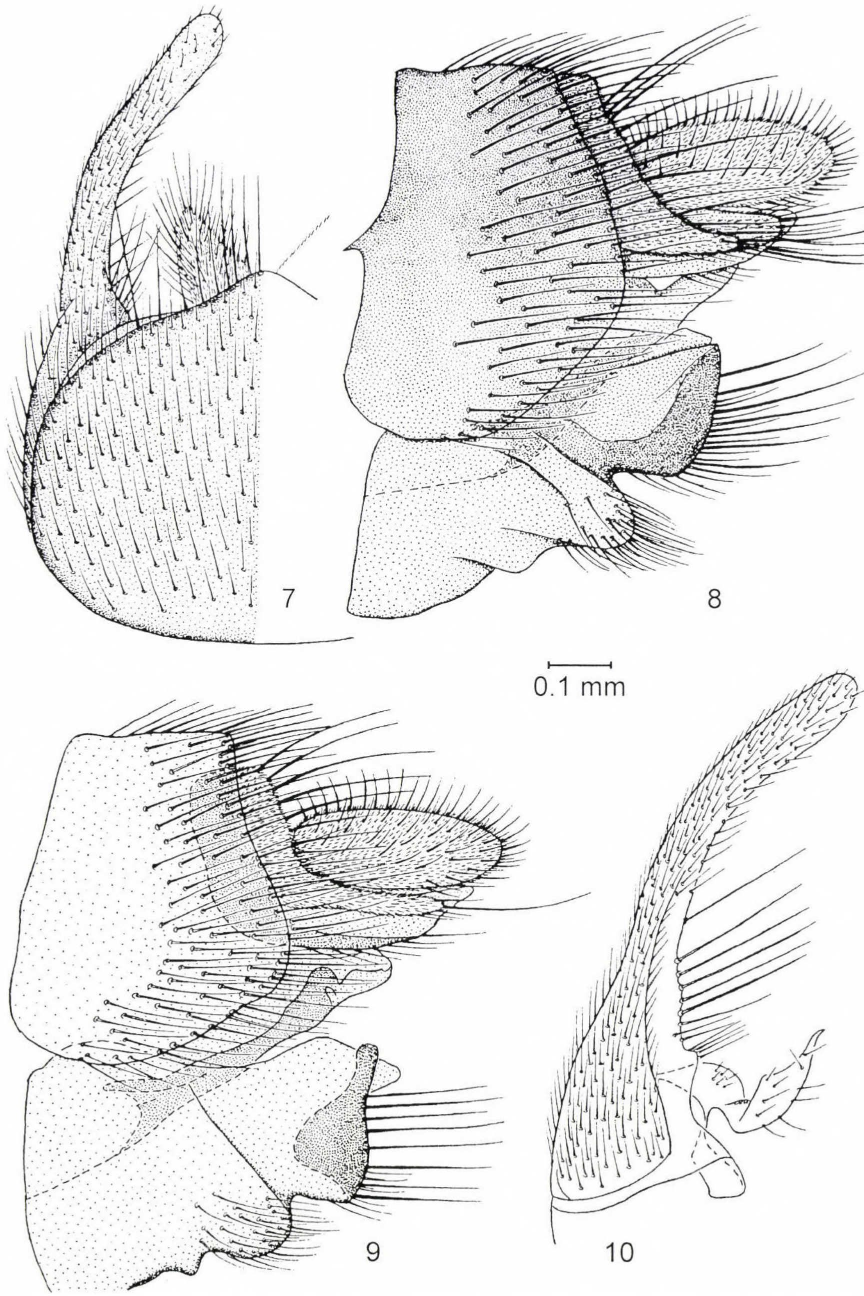
Leptomorphus quadrimaculatus (MATSUMURA, 1916)
(Figs 1, 3, 8, 12)

Boletina quadrimaculatus MATSUMURA, 1916: 440;
Lepitomorphus 4-maculata, OKADA, 1936: 99 (lapsus calami);
Lepitomorphus 4-maculatus, OKADA, 1939: 302.

Material examined. Russia: Primorsky Reg., Lazo, Sokolchi, 11.VII.1979, 5 ♂♂, 4 ♀♀, Zaitzev leg.; the same data, 21.VII.1979, 1.VIII.1979, 2 ♂♂, Zaitzev leg.; Primorsky Reg., Kedrovaya Pad Reserve, IX.1960, 1 ♂, 1 ♀, Krivosheina leg.; Khabarovsky Reg., Bychikha, 3.VII.1975, 1 ♂, Mamaev leg.; Tuva, Ishtii-Hem, 13.VIII.1979, 1 ♂, Krivosheina leg. (IEE).

Description. Male. Head dark brown, palpus yellow; antenna dark brown, sixth flagellar segment twice as long as broad. Thorax dark brown, mesonotum shining. Wing length 6.5–8 mm, wing with dark central spot extending from Sc to stem of M fork, preapical band extending back to wing margin, clouds present also between branches of Cu fork and behind Cu2; stem of M fork 2.5 times as long as rm, base of Cu fork before base of rm. Halteres with brownish knobs. Legs yellow, basal parts of first and hind coxae dark, first basitarsus twice as long as fore tibia; fore tibia with 14–15 a, 6–7 d, 7–12 pd, 12–14 p, numerous v, arranged in irregular rows; mid tibia with 14–15 a, 11–13 d, 14–21 pd, 14 p, 5–8 v, 10–11 av; hind tibia 19–20 a, 18–21 d, 21–23 pd, 18–20 p, 7–10 pv, 14 v. Abdomen shining dark brown. Terminalia brown.

Female. Similar to male in coloration. Ovipositor light brown, cerci yellow.



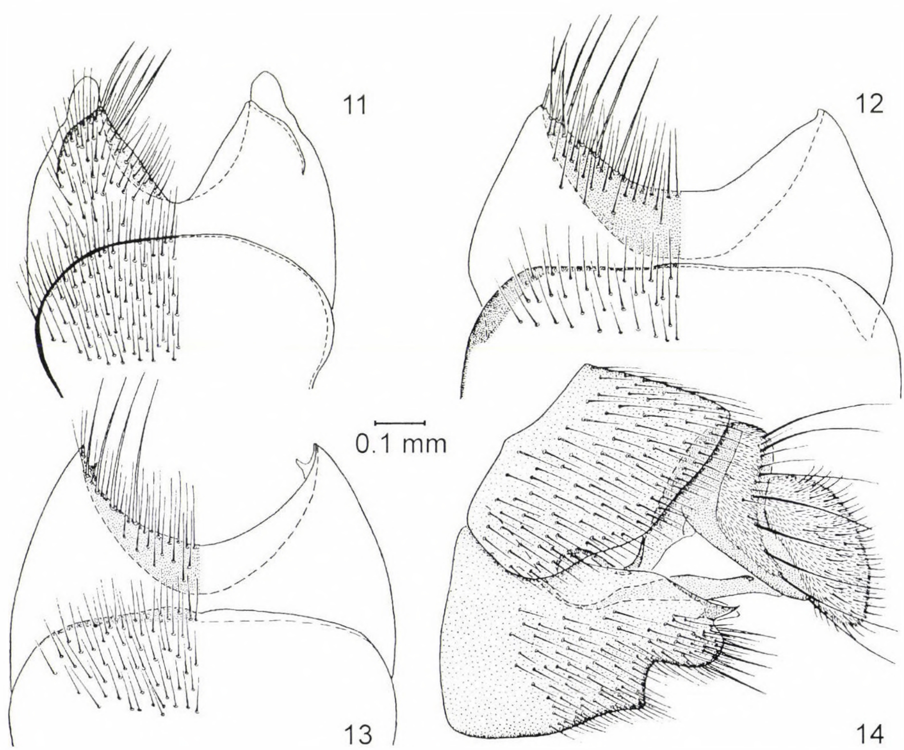
Figs 7–10. *Leptomorphus* WALK.: 7, 10 – *L. forcipatus* (Czech Republic, Šilheřovice); 8 – *L. quadrimaculatus* (Russia, Lazo); 9 – *L. subforcipatus* sp. n. (Russia, Moscow region): 7 = male terminalia (dorsal view); 8, 9 – female terminalia (lateral view); 10 = gonostylus (ventral view)

Leptomorphus subforcipatus sp. n.
(Figs 2, 6, 9, 13)

Leptomorphus forcipatus, KRIVOSHEINA, ZAITZEV, YAKOVLEV, 1986, fig. 36, 6;
Leptomorphus quadrimaculatus, ZAITZEV, 1994 (part), fig. 54, 4; Zaitzev, 1999, fig. 99, 5.

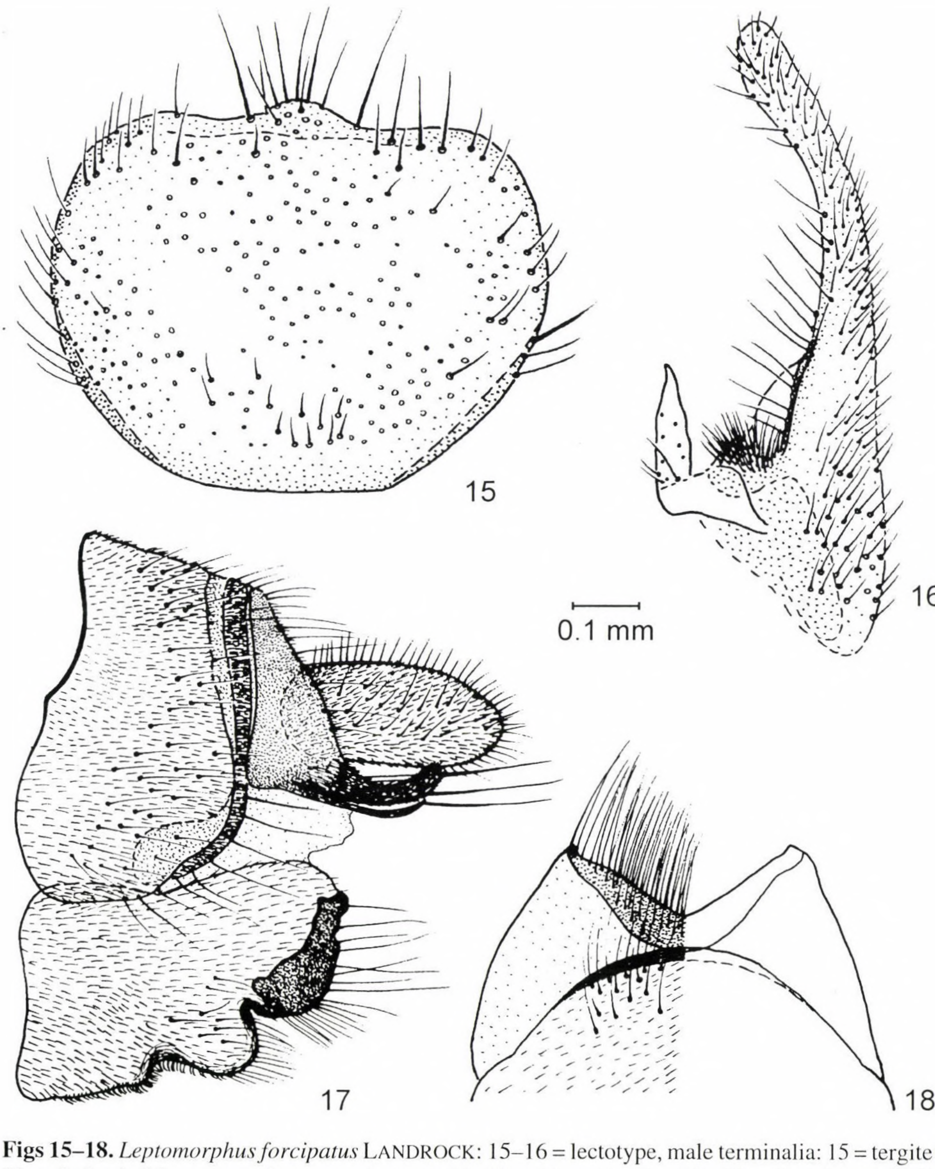
Material examined. Holotype ♂: Russia, Moscow Reg., Pavlovskaya Sloboda, 10.VII.1982, Zaitzev leg. (IEE). Paratypes. Russia: 4 ♂♂, 1 ♀, with the same data; 3 ♂♂, Moscow Prov., Ovrazhki, 30.VII.1984, Zaitzev leg.; 1 ♂, Moscow Reg., Anikeevka, 15.IX.1982, Zaitzev leg.; 1 ♂, Kostroma Prov., Ugory, 8.IX.1981, Zaitzev leg.; 1 ♂, Karelia, Tolvoyarvi, 29.VI–2.VII.1998, Tietäväinen leg.; Finland, 1 ♂, Ilomantsi, Tapionaho, 7–28.VII. 1993, Yakovlev leg. (IEE).

Description. Male. Head dark brown, clypeus light brown or yellow, palpus yellow; antenna dark brown, scapus and pedicel yellow, sixth flagellar segment twice as long as broad. Thorax two-coloured, mesonotum shining dark brown with yellow hind corners, scutellum brown, mediotergite yellow with brown central area, laterotergite yellowish brown. Wing length 6–8 mm, wing with dark



Figs 11–14. *Leptomorphus* WALK.: 11, 14 – *L. talyshensis* sp. n. (paratype); 12 – *L. quadrimaculatus* (Russia, Lazo); 13 – *L. subforcipatus* sp. n. (Russia, Moscow region): 11–13 = female sternite 8 (ventral view); 14 = female terminalia (lateral view)

central spot, extending from Sc to stem of M fork, preapical band extending from Sc to stem of M fork, preapical band extending back to wing margin, clouds present also between branches of Cu fork and behind Cu2, stem of M fork 2.5 times as long as rm, base of Cu fork before base of rm. Halteres with brownish knobs. Legs yellow, first tarsomere 1.5 times as long as fore tibia, fore tibia with 9–10



Figs 15–18. *Leptomorphus forcipatus* LANDROCK: 15–16 = lectotype, male terminalia: 15 = tergite 9 (dorsal view); 16 = gonostylus (ventral view); 17–18 = Slovakia, Nová Sedlica, female terminalia: 17 = lateral view; 18 = sternite 8 (ventral view)

a, 4–6 d, 5 pd, 7–8 p, 5–9 pv, numerous v, arranged in 2 irregular rows; mid tibia with 9–12 a, 6 d, 7–11 pd, 9–10 p, 3–5 pv, 4–7 v; hind tibia with 9–14 a, 11–13 d, 12–13 pd, 11–12 p, 7 v, 4–7 av. Abdomen brown. Terminalia yellowish brown.

Female. Similar to male in coloration. Ovipositor yellow.

Remark. This species is very close to *L. quadrimaculatus* (MATSUMURA), from which it differs in the coloration of thorax and in the shape of gonostylus.

Leptomorphus talyshensis sp. n.
(Figs 4, 5, 11, 14)

Material examined. Holotype ♂: Azerbaijan, Avrora, 13.V.1980, Zaitzev leg. Paratypes: ♂, ♀, with the same data (IEE).

Description. Male. Head yellow, vertex light brown, clypeus and palpus yellow, antennae with sixth flagellar segment twice as long as broad. Thorax two-coloured; mesonotum shining dark brown with yellow lateral parts, laterotergite yellow with brownish lower margin, pleuron yellow. Wing length 7 mm, wing with dark central spot, starting from Sc and ending behind stem of M fork, apical part of wing darkened, clouds present also between branches of Cu fork and behind Cu2; stem of M fork 3.5 times as long as rm, base of Cu fork under base of rm. Halteres with brown knobs. Legs yellow, first tarsomere twice as long as fore tibia, fore tibia with 6–8 a, 2 d, 1–3 pd, 5 p, 6 pv, 15 v; mid tibia with 16 a, 8 ad, 5 d, 8 pd, 6 p, 3–4 v; hind tibia with 8 a, 10 ad, 8 d, 6 pd, 4 p, 4 v. Abdomen two-coloured, tergites 1–5 yellow with dark brown hind margins, tergite 6 dark brown with narrow yellow fore margin. Terminalia yellow.

Female. Similar to male in coloration. Ovipositor yellow.

Remarks. This species is close to *L. forcipatus* LANDROCK, from which it differs mainly in the coloration of abdomen and in the shape of gonostylus.

KEY TO SPECIES

1 Wing with dark central spot extending from Sc to stem of M fork and pre-apical band extending back to wing margin. Base of Cu fork before base of rm. Abdomen shining dark brown ... 2

– Wing with dark central spot starting from Sc and ending behind stem of M fork. Base of Cu fork under base of rm. Abdomen two-coloured, tergites 1–5 yellow with dark brown hind margins. Male terminalia as on Figs 4, 5; ovipositor as on Figs 11, 14 ... *L. talyshensis* sp. n.

2 Thorax unicolorous dark brown. Male terminalia as on figs 1, 3; ovipositor as on Figs 8, 12 ... *L. quadrimaculatus* (MATSUMURA)

– Thorax two-coloured, mesonotum dark brown with yellow hind corners, pleurae yellow or light brown, mediotergite yellow with brownish central area 3

3 Gonostylus with distinct triangular projection directed medially (Fig. 2) *L. subforcipatus* sp. n.

– Gonostylus without triangular projection directed medially (Fig. 10) *L. forcipatus* LANDROCK

*

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ON THE IDENTITY AND SYSTEMATIC POSITION OF HYSTEROPTERUM PICTIFRONS MELICHAR, 1906 (HOMOPTERA: CICADINA, ISSIDAE)

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Bubastia pictifrons (MELICHAR, 1906), comb. n. (= *kulikiana* LOGVINENKO, 1977, syn. n.) is redescribed and its lectotype is designated. *Verticisium* DLABOLA, 1979 is placed in synonymy with *Tautoprosopa* EMELJANOV, 1978, stat. n. With 8 figures.

Key words: *Hysteropterum pictifrons*, *Verticisium*, *Bubastia*, *Tautoprosopa*, Homoptera, Cicadina, Issidae, stat. n., comb. n., syn. n., lectotype

INTRODUCTION

Up to now the species name *Hysteropterum pictifrons* MELICHAR, 1906 was applied incorrectly to *Tautoprosopa transcaspia* EMELJANOV, 1978 (LINNAVUORI 1952, DLABOLA 1979). In course of the present study the type specimens of *H. pictifrons* were examined. According to its external characters and structure of genitalia, this species should be placed in the genus *Bubastia* EMELJANOV, 1975. The genus *Verticisium* DLABOLA, 1979 is placed in synonymy with the genus *Tautoprosopa* EMELJANOV, 1978.

This study is based on specimens deposited in the following collections: HNHM – Hungarian Natural History Museum, Budapest, Hungary; ZIN – Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.

Bubastia pictifrons (MELICHAR, 1906), **comb. n.** (Figs 1–8)

Hysteropterum pictifrons MELICHAR, 1906: 140 (non LINNAVUORI, 1952; DLABOLA, 1979, 1982).
Bubastia kulikiana LOGVINENKO, 1977: 63–64, Fig. 3, **syn. n.**

Lectotype of *H. pictifrons* (designated here to fix the application of the species name), male, HNHM, "Armenia / Kulp" (hand written), "*Hysteropterum pictifrons* Mel." (written by HORVÁTH), "*Hysteropterum pictifrons* Mel. det. Horváth" (hand written), "Coll. Horváth".

Paralectotypes. HNHM: 2 females, "Armenia / Kulp", "*Hysteropterum pictifrons* Mel. det. Horváth" (hand written), "Coll. Horváth"; 2 males, 1 female, "Armenia / Kulp", "*pictifrons* Mel.

(with red underline) Coll. Horváth" (species name written by HORVÁTH), "*Hysteropterum pictifrons* Mel. det. Horváth" (museum label), "Coll. Horváth".

Additional material examined. ZIN: Armenia: 4 males, Yerevan, 3. and 14.VIII.1935, leg. M. E. Ter-Minassian and A. A. Richter; 2 males, 1 female, Dzhrvezh near Yerevan, 23.IX.1956, leg. V. A. Triapitzin; 5 males, 11 females, Alaverdsky Distr., Lori, pr. Achtala 28. and 30.VIII.1923 (collector's name not given).

Description. Coryphe transverse, its anterior margin straight, hind margin concave. Metope with median and sublateral keels. Median keel continued on clypeus. Sublateral keels weakened in distal part of metope. Fore wings without hypocostal lobe; R bifurcate; M trifurcate; CuA not branched. Hind wings vestigial. Hind tibia with 2 lateral teeth; its apex with 8–10 setae. First segment of hind tarsus with 4 apical setae.

General coloration yellowish brown. Dark brown stripes and spots sometimes present on fore wings and legs.

Male. Anal tube (X segment) elongate, broadened in distal part and widely rounded at apex. Anal column (XI segment) short. Penis slender, slightly curved (lateral view). Phallobase with lateral serrate lobes distally. Ventral lobe of phallobase elongate and enlarged distally. Aedeagus with 2 pointed hooks half as long as phallobase. Hind margin of stylus concave. Apical tooth of stylus beak-shaped, bent ventrad; subapical tooth flattened.

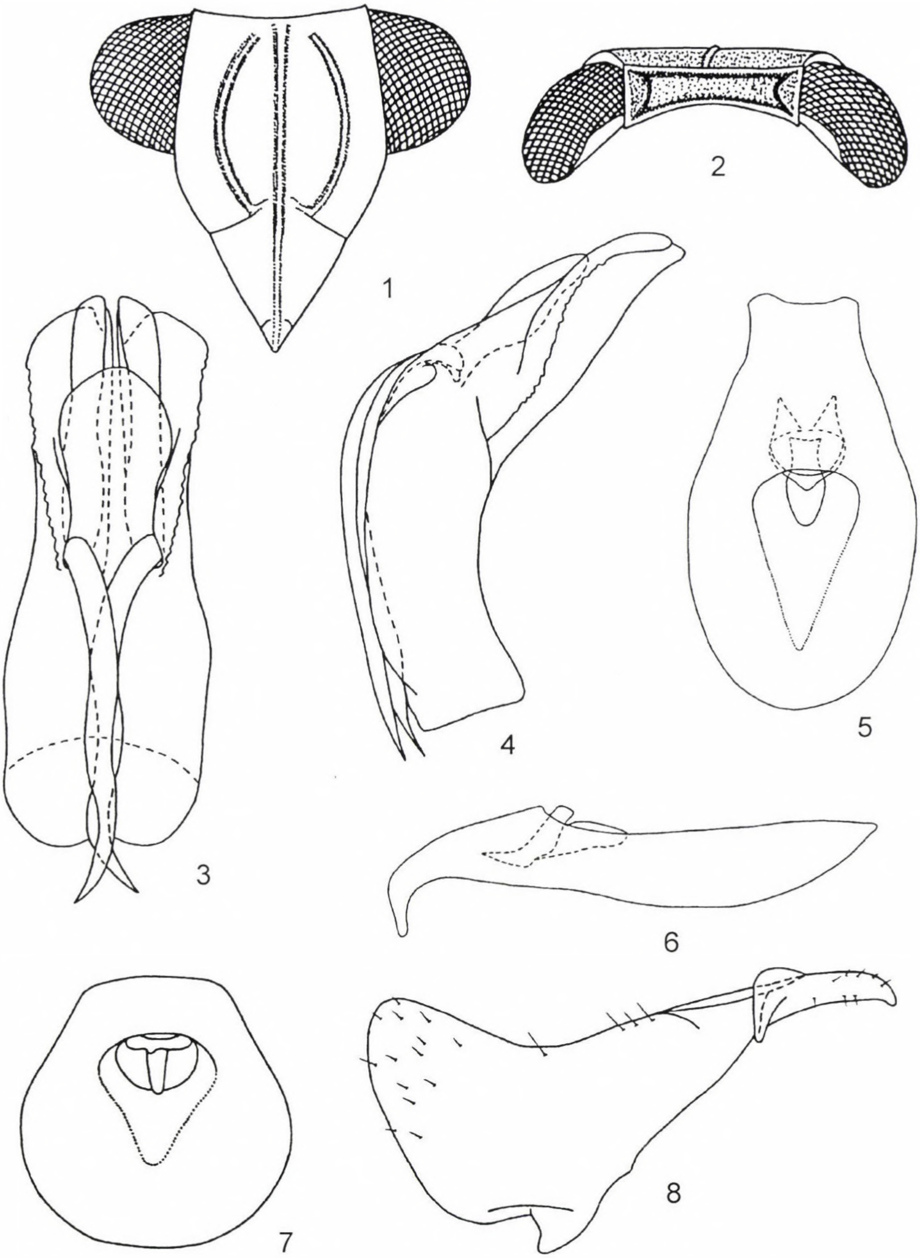
Female. Anal tube strongly widened (dorsal view). Anal column short.

Body length. Male: 3.1–3.4 mm; female: 3.4–3.8 mm.

Distribution. S Armenia and E Turkey (Kulp).

Comparison. Based on the structure of the male genitalia, *B. pictifrons* is closely related to *B. midica* LOGVINENKO, 1975 from the Nakhichevan Republic and other regions of Azerbaijan, and to *B. karabachica* LOGVINENKO, 1975 from the Karabakh Range in Azerbaijan (LOGVINENKO 1975). The synonymy of *B. kulikiana* LOGVINENKO, 1977, described from environs of Yerevan, is based on examination of the original description.

Discussion. MELICHAR (1906: 140) described *Hysteropterum pictifrons* from Armenia and stated that a pair of specimens is deposited in the Hungarian Natural History Museum. For the first time *H. pictifrons* was used by HORVÁTH (1899) as nomen nudum for specimens collected in Kulp (Turkey). Probably, HORVÁTH gave the material of the new species from Kulp to MELICHAR for description and MELICHAR retained the species name proposed by HORVÁTH in 1899. MELICHAR described the coloration of fore wings as follows: "Deckflügel beim ♂ bräunlichgelb, beim ♀ häufig mit schwarzer Zeichnung". The use of the word "häufig" [often] shows that he examined at least 3 females, and in fact, of the 3 females from HNHM two have a black pattern. I suspect therefore that the material examined by MELICHAR comprised 3 pairs (not one), which corresponds to the number of specimens in HNHM. I consider all 6 specimens deposited in Budapest as type specimens of *H. pictifrons*.



Figs 1–8. *Bubastia pictifrons* (MELICHAR), male (lectotype) and female (paralectotype): 1 = male head (ventral view), 2 = male head (dorsal view), 3 = penis (ventral view), 4 = penis (lateral view), 5 = male anal tube (dorsal view), 6 = male anal tube (lateral view), 7 = female anal tube (dorsal view), 8 = stylus (ventral view)

Genus *Tautoprosopa* EMELJANOV, 1978, **stat. n.**

Tautoprosopa EMELJANOV, 1978: 332 (as subgenus of *Brachyprosopa* KUSNETZOV, 1928). Type species: *Brachyprosopa transcaspia* EMELJANOV, 1978. *Verticisium* DLABOLA, 1979: 281–282, **syn. n.**

Type species now fixed (under Article 70.3 of the Code) as *Tautoprosopa transcaspia* EMELJANOV, 1978, misidentified as *Hysteropterum pictifrons* MELICHAR, 1906 in the original designation by DLABOLA (1979).

Comparison of the type material of *Tautoprosopa transcaspia* EMELJANOV, 1978 with the description and figures in the paper by DLABOLA (1979) shows that DLABOLA had to do with this species, and not with *Hysteropterum pictifrons* MELICHAR, 1906.

Tautoprosopa transcaspia EMELJANOV, 1978

Brachyprosopa (Tautoprosopa) transcaspia EMELJANOV, 1978: 332, Fig. 33.
Hysteropterum pictifrons (non MELICHAR, 1906): LINNAVUORI, 1952: 191, Fig. 4, F-J.
Verticisium pictifrons (non MELICHAR, 1906): DLABOLA, 1979: 282–283, Figs 103–110.

Material examined. ZIN: male (holotype); 9 males and 3 females (paratypes).

Distribution. SW Kazakhstan, W Turkmenia, N Iran (Mazandaran).

Discussion. LINNAVUORI (1952) based on examination of material from "Transcaspia" misidentified *T. transcaspia* EM. as *H. pictifrons* MEL. DLABOLA (1979) based on figures of *H. pictifrons* (non MELICHAR, 1906) in the paper by LINNAVUORI recorded this species from North Iran.

Latilica maculipes (Melichar, 1906)

Hysteropterum maculipes MELICHAR, 1906: 141.
Dalmatrium pictifrons (non MELICHAR, 1906): DLABOLA, 1982: 157.

As a result of a *lapsus calami*, DLABOLA (1982) used the name *Hysteropterum pictifrons* MELICHAR, 1906 instead of *H. maculipes* MELICHAR, 1906. *Dalmatrium* DLABOLA, 1980 is a junior synonym of *Latilica* EMELJANOV, 1971 (see EMELJANOV 2001). Dlabola (1982) actually synonymized *H. issifrons* BERGEVIN, 1918 and *H. oertzeni* MATSUMURA, 1910 with *H. maculipes*, not with *H. pictifrons*.

*

Acknowledgements – I am grateful to Mr. A. OROSZ (Hungary, Budapest) for a loan of the type material of *H. pictifrons* MEL. for study and Dr. I. M. KERZHNER (Russia, St. Petersburg) for consultations.

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The distribution of Hungarian molluscs

The catalogue of the Mollusca Collection of the Hungarian Natural History Museum

Z. Fehér and A. Gubányi

Authors aimed to continue the traditions of Hungarian faunal mapping set by Pintér and co-workers in 1979, and to create a computer programme and a database, that are able to collect and manage data both from the literature and collections and able to create distribution maps. Due to this "living" data system, where the integration of new data is permanently done and the errors are continuously corrected, the results are published in electronic format in English and Hungarian. The CD contains the catalogue in pdf format (the reader programme Adobe Acrobat Reader 4.0 also present). As the first step, this CD contains the checklist of the Hungarian molluscs and their distribution data based on the Mollusca Collection of the Hungarian Natural History Museum. Distribution of the 220 gastropod and 24 bivalve species in the collection are illustrated in 10×10 km UTM grid maps, and all of their sampling sites are listed by UTM grids.

The checklist follows the nomenclature of the CLECOM (Check-list of the European Continental Mollusca) project. With all those speciess that are known under a different synonym name in Hungary, or occur in Hungary but not mentioned in the CLECOM list, or are missing from the HNHM collection, or that are incorrectly indicated in Hungary, or their taxonomic position is judged by a competent Hungarian malacologist in another way then given in CLECOM, authors deal with in the Appendix. A glossary of the frequently used common names and geographical terms helps the use of the locality list. This issue will hopefully be followed by others containing literature data and data of other Hungarian mollusc collections, and the series will become a useful tool for malacologists dealing with zoogeography, ecology and nature conservation.

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NEW SPECIES OF HOPLOSEIUS BERLESE 1914 (ACARI: GAMASIDA, ASCIDAE) FROM POLAND

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This work presents a description and figures of a new species of the genus *Hoploseius*. The species was recorded in fungal fruiting bodies in West Poland. This is the first record of the genus in Europe.

Key words: mites, Acari, Gamasida, Ascidae, *Hoploseius*

INTRODUCTION

The genus *Hoploseius* was described by BERLESE (1914), who revised his own description of the species *Zercon cometa* of four years earlier (BERLESE 1910).

All species of the genus *Hoploseius* described so far are associated with fungal fruiting bodies or phoretic on insects found on fruiting bodies. They have been observed in Africa, North America, Australia and Asia. *Hoploseius cometa* (BERLESE, 1910) was collected from a brachycerous fly from Java and from polypores in Sumatra. *H. drosophili* CHANT, 1963 was observed on Mycodrosophila flies in North America, *H. bakeri* LINDQUIST, 1963 was collected from shelf fungi in the Congo, *H. tenuis* LINDQUIST, 1965 was recorded on coniferous bracket fungi in Mexico, *H. sitalaensis* BHATTACHARYYA, 1977 from "*Agaricus* sp." in India, and *H. australianus* WALTER, 1998 from white polypore shelf fungus in Australia (CHANT 1963, LINDQUIST 1963, 1965, BHATTACHARYYA 1977, WALTER 1998).

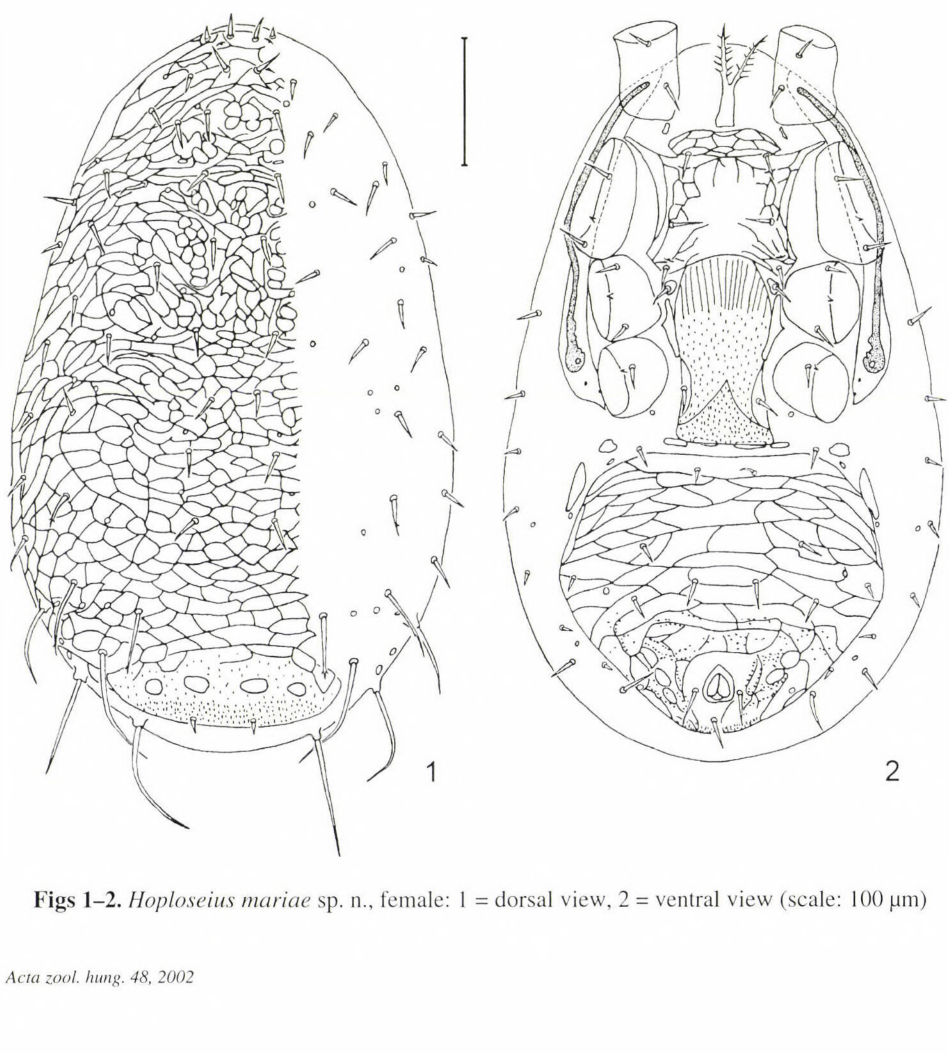
Fruiting bodies of several species of fungi collected in West Poland (Wałcz Forest District) (GWIAZDOWICZ & ŁAKOMY 2002) yielded a new species of the genus *Hoploseius* whose description is presented below. Until now, this genus has not been recorded in Europe (KARG 1993). Prof OLGA MAKAROVA observed one individual of this genus in North-eastern Europe, but it has not been published yet.

Hoploseius mariae sp. n.
(Figs 1–8)

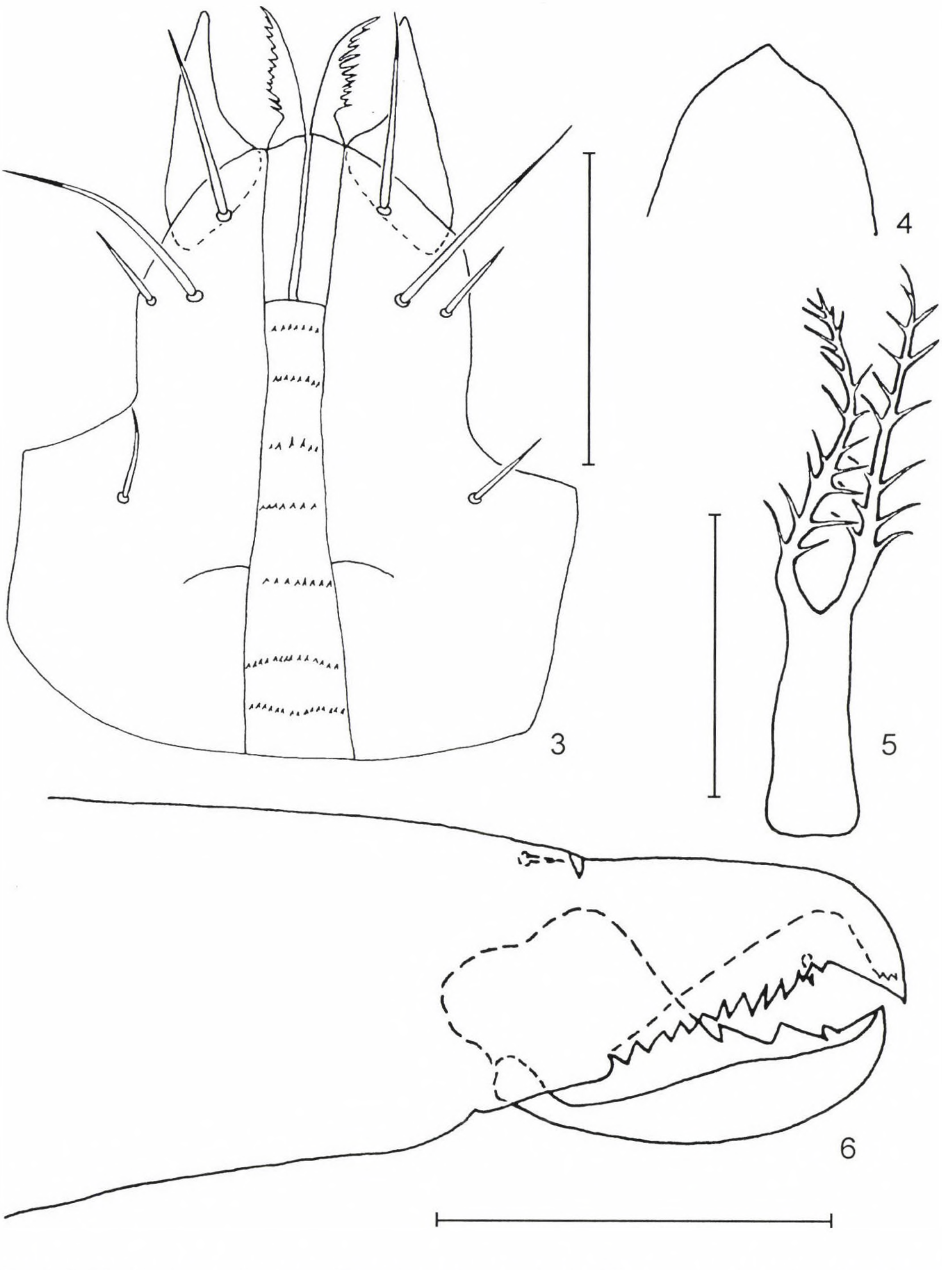
Holotype: 1 female collected from the fruiting body *Trametes versicolor* (L. ex Fr.) Pil. on 18.04.1998 in Wałcz Forest District, leg. P. Łakomy.

Paratypes: 327 females obtained from fruiting body *Trametes versicolor*, 144 females from fruiting body *Bjerkandera adusta* (Willd ex Fr.) P. Karst., 106 females collected from *Deadalea quercina* L. ex Fr., 22 females from *Fomitopsis pinicola* (Swartz ex Fr.) P. Karst. All fruiting bodies were obtained in Wałcz Forest District on 18.04.1998, leg. P. Łakomy. One female was extracted from a litter sample collected from the Karkonosze National Park (compartment 214 G), on 12.06. 2000, leg. D. J. Gwiazdowicz.

Holotype and same paratypes are deposited in the author's collection; other paratypes in the Canadian National Collection of Insects and Arachnids.



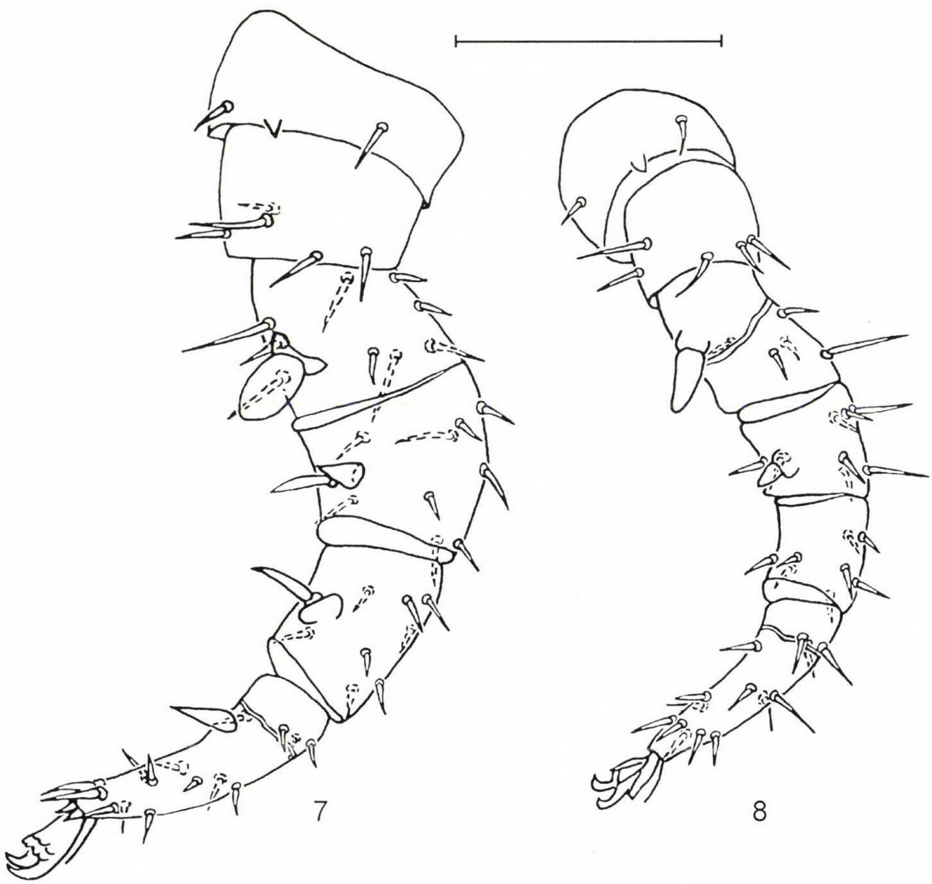
Figs 1–2. *Hoploseius mariae* sp. n., female: 1 = dorsal view, 2 = ventral view (scale: 100 μm)



Figs 3–6. *Hoploseius mariae* sp. n., female: gnathosoma (scale: 50 µm), 4 = tectum, 5 = tritosternum (scale: 40 µm), 6 = chelicera (scale: 100 µm)

Description of female. Length of idiosoma 570–600 µm, width 350–370 µm. Body oval, egg-shaped, holodorsal shield with distinct ornamentation (Fig 1). Holodorsal shield bearing 35 pairs of setae. Most setae similar in length to that of i4 (20 µm). Only setae r1 and J5, with length 10 µm, are markedly shorter. Setae Z2 (30 µm), J4 (45 µm), Z3, S4 (55 µm), S5 (75 µm), Z4, Z5 (90 µm) are longer. All setae are simple, only Z2, Z3 and J4 are occasionally weakly tricarinate. Pores, e.g. ip3, ip4, zp1, JP3, JP2, ZP3, ZP4, SP4 situated typically for the genus *Hoploseius*.

Idiosomal venter with reticulate sternal shield, which bears simple setae st1–3 and pores stp1–2 (Fig. 2). Metasternal plates drop-shaped with simple seta st4. Epigynial shield punctured, bearing simple seta st5. Simple seta ZV1 anterior to ventrianal shield on soft cuticle. Ventrianal shield (235×270 µm) subcordate, reticulate, punctured in posterior third, with five pairs of simple ventral setae JV1–3, ZV2–3, paranal setae and postanal seta. Setae JV1 (10 µm) markedly shorter than setae JV2 (20 µm). Located posteriorly to anal opening is a narrow cribrum of two rows of denticles. Seta JV5 (30 µm), posterior to ventrianal shield, is markedly longer than JV4 (10 µm). Peritrema situated on peritrematic shield, which extends from coxa I to coxa IV. This shield is mark-



Figs 7–8. *Hoploseius mariae* sp. n., female: 7 = leg II, 8 = leg III (scale: 100 µm)

edly longer than peritrema and elongated below stigma. On peritrematic shield posterior to stigma there is a post-stigmatic pore.

Ventral side of hypostome (Fig. 3) with horn-like corniculi and 4 pairs of simple setae, the longest among them being C3 (40 µm), then C1 (30 µm), C2 and C4 (15 µm). Deutosternum with 8 distinct transverse rows, of which 7 have denticles Q1 (0), Q2 (5–8), Q3 (6–8), Q4 (6–8), Q5 (6–8), Q6 (6–9), Q7 (13–16), Q8 (13–16). Tectum (Fig. 4) is smooth and subtriangular. Tritosternum (85 µm) with strongly plumose laciniae (50 µm) (Fig. 5). Fixed digit of chelicera with row of 11 teeth and distal rasp with 3–4 teeth and spine-like pilus dentilis. Movable digit with three teeth (Fig. 6).

Legs of varying length, I (420 µm), II (360 µm), III (310 µm), IV (420 µm). Setation of leg I: coxa (2), trochanter (5), femur (12), genu (11), tibia (11); leg II: coxa (2), trochanter (5), femur (9+1), genu (10+1), tibia (9+1); leg III: coxa (2), trochanter (5), femur (5+1), genu (8+1), tibia (8); leg IV: coxa (1), trochanter (5), femur (7), genu (9), tibia (10). Femur II, genu II tibia II, tarsus II as well as femur III and genu III bearing spine-like setae (Figs 7, 8).

Hoploseius mariae sp. n. resembles *H. australianus* and *H. bakeri*. According to WALTER (1998), the major difference between these species are the spine-like setae on leg III. *H. bakeri* has no such setae on leg III. In *H. australianus* only femoral seta av is spine-like, while in *H. mariae* both femoral and genual seta av are spine-like. Moreover, the species differ in body size: *H. australianus* (480–540 µm), *H. bakeri* (447 µm), *H. mariae* (580–600 µm). These differences also concern setal length both on dorsal and ventral side, e.g. in *H. mariae* setae Z4 and Z5 are of equal length (length of up to 90 µm), while in *H. australianus* setae Z4 (90 µm) is markedly longer than Z5 (75 µm). In *H. australianus*, length of setae S4 equals that of S5 (50–60 µm), while in *H. mariae* S5 (75 µm) is markedly longer than S4 (55 µm).

Etymology: The species is dedicated to my daughter MARIA MAGDALENA GWIAZDOWICZ.

*

Acknowledgement – Special thanks to Dr. E. E. LINDQUIST for his assistance during the determination of material and for valuable comments concerning differences between *Hoploseius australianus* and *H. mariae*.

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SYSTEMATIC STUDIES ON ZERCONID MITES (ACARI: GAMASIDA, ZERCONIDAE) OF TURKEY

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In this study, two new species of zerconid mites, *Zercon kackaricus* and *Z. delicatus*, from Turkey are described and illustrated. Additionally, a key to the adults of the genus *Zercon* known from Turkey is given.

Key words: *Zercon*, Gamasida, Acari, systematics, Turkey

INTRODUCTION

The family Zerconidae is well known from the Holarctic region (KRANTZ 1978, BALAN 1992). Zerconids are soil mites of idiosomal length varying between 200–700 μm. These mites are weakly sclerotized and their life cycle include four active stages; larva, protonymph, deutonymph and adult. Zerconids are free-living mites occurring in humus, litter and among mosses. Zerconids are oligophagous predators and their diet include nematodes (MARTIKAINEN & HUHTA 1990).

In Turkey, the first study of zerconids was published by BŁASZAK (1979) and further studies were made by URHAN and AYYILDIZ (1994*a, b*, 1996*a–e*) and URHAN (1997, 1998*a, b*, 2001*a–e*). During the studies on the family Zerconidae in Turkey we found two undescribed species of the genus *Zercon*. This paper presents their descriptions. Morphological terminology follows that of SELLNICK (1958) and BŁASZAK (1974).

MATERIALS AND METHODS

Soil and litter samples were collected from Artvin, Yusufeli village. The samples were placed into plastic bags, labelled and transferred to the laboratory. Afterwards, the soil and litter samples were placed into combined Berlese funnels and mites were extracted for 5–7 days according to their humidity. At the end of this process, the contents of bottles were transferred into petri dishes and mites were separated under a stereo-microscope. They were placed in lactic acid in order to facilitate examination. The examination and drawing of mites were made under an Olympus BX50 microscope.

DESCRIPTION OF THE NEW SPECIES

Zercon kackaricus sp. n.
(Figs 1A–D)

Type material. Holotype ♀. "Turkey, Artvin, Yusufeli, Yaylalar village, Kackar mountains, 2100 m, 23 June 1994, collected by R. Urhan." Sample from litter and soil underlying *Rosa canina*. Paratypes: 6 ♀♀, 3 ♂♂; from the same sample. Type deposition: holotype and 3 paratypes (2 ♀♀, 1 ♂) at the Zoological Museum of Atatürk University, Erzurum, Turkey; other paratypes (4 ♀♀, 2 ♂♂) are deposited in the authors' collection.

Female (Figs 1A, B). Length of idiosoma (excluding gnathosoma) of holotype 500 µm, width 364 µm. Measurement of 6 paratypes; mean length 498 (490–508) µm, mean width 364 (360–368) µm.

Dorsal setae (Fig. 1A). On the podonotum seta j1 feathered, setae r3–r6 delicately barbed. The remaining setae of podonotum smooth. On the opisthonotum setae J_1–J_5 long and delicately barbed. Seta J_3 not reaching the base of seta J_4. Seta J_4 reaching to the base of seta J_5. Seta J_6 long and barbed with hyaline ending. Seta J_6 126 µm (on average) apart from each other. Setae Z_1–Z_3 long and delicately barbed. Seta Z_3 not reaching the base of seta Z_4. Seta Z_4 similar to seta J_6, exceeding a third of its length beyond margin of opisthonotum. Seta Z_5 similar to seta Z_1. The distance between setae Z_5–J_6 is 31 µm. Setae S_1–S_3 similar to seta Z_3. Seta S_4 long and barbed with hyaline ending. Setae R_1–R_4 delicately barbed, the remainder of this row smooth. Lengths and their mutual distances of opisthonotal setae are given in Table 1.

Table 1. Lengths and their mutual distances (M. dist.) of opisthonotal setae

Length	M. dist.	Length	M. dist.	Length	M.dist.
S_1–26 (24–27)	34 (31–37)	Z_1–25 (24–27)	54 (52–58)	J_1–28 (27–31)	48 (44–52)
S_2–30 (27–31)	44 (37–48)	Z_2–28 (27–31)	37 (35–41)	J_2–32 (31–34)	48 (46–50)
S_3–33 (31–34)	68 (65–70)	Z_3–33 (31–34)	41 (37–44)	J_3–33 (31–34)	37 (34–38)
S_4–62 (58–65)		Z_4–64 (62–65)	68 (65–70)	J_4–33 (31–34)	33 (31–34)
		Z_5–26 (24–27)		J_5–33 (31–34)	44 (41–45)
				J_6–67 (65–68)	

Pores. Pore po_1 situated anterior to the line connecting setae s_2–j_3. Pore po_2 under the line connecting setae s_4–j_4. Pore po_3 inside the line connecting setae s_5–s_6. Pore Po_1 located anteroparaxially to the insertion of seta Z_1. Pore Po_2 posterior to the line connecting setae S_2–Z_2. Pore Po_3 lies on the line connecting setae S_4–Z_4. Pore Po_4 lies on the line connecting setae S_4–Z_5, shifted toward seta S_4.

Sculpturing pattern. The ornamentation of the dorsal shields is shown in Figure 1 A. Dorsal cavities distinct, well sclerotized, equal in size, with axes parallel the body axis.

Venter (Fig. 1B). The chaetotaxy and shape of the peritrematal shield typical for the genus. Adgenital shields present. With four setae on the anterior margin of the ventro-anal shield.

Male (Figs 1C, D). Idiosoma (excluding gnathosoma) in 3 specimens; mean length 402 (398–405) µm, mean width 272 (270–274) µm. Setae, pores and sculpturing pattern on the podo- and opisthonotum as in female. The distance between setae J_6-J_6 and Z_5-J_6 average 102 µm and 27 µm, respectively. Lengths and their mutual distances of opisthonotal setae are given in Table 2.

Distribution. Artvin, Turkey.
Etymology. The new species is named after its locality which is Kackar Mountains (Turkey).

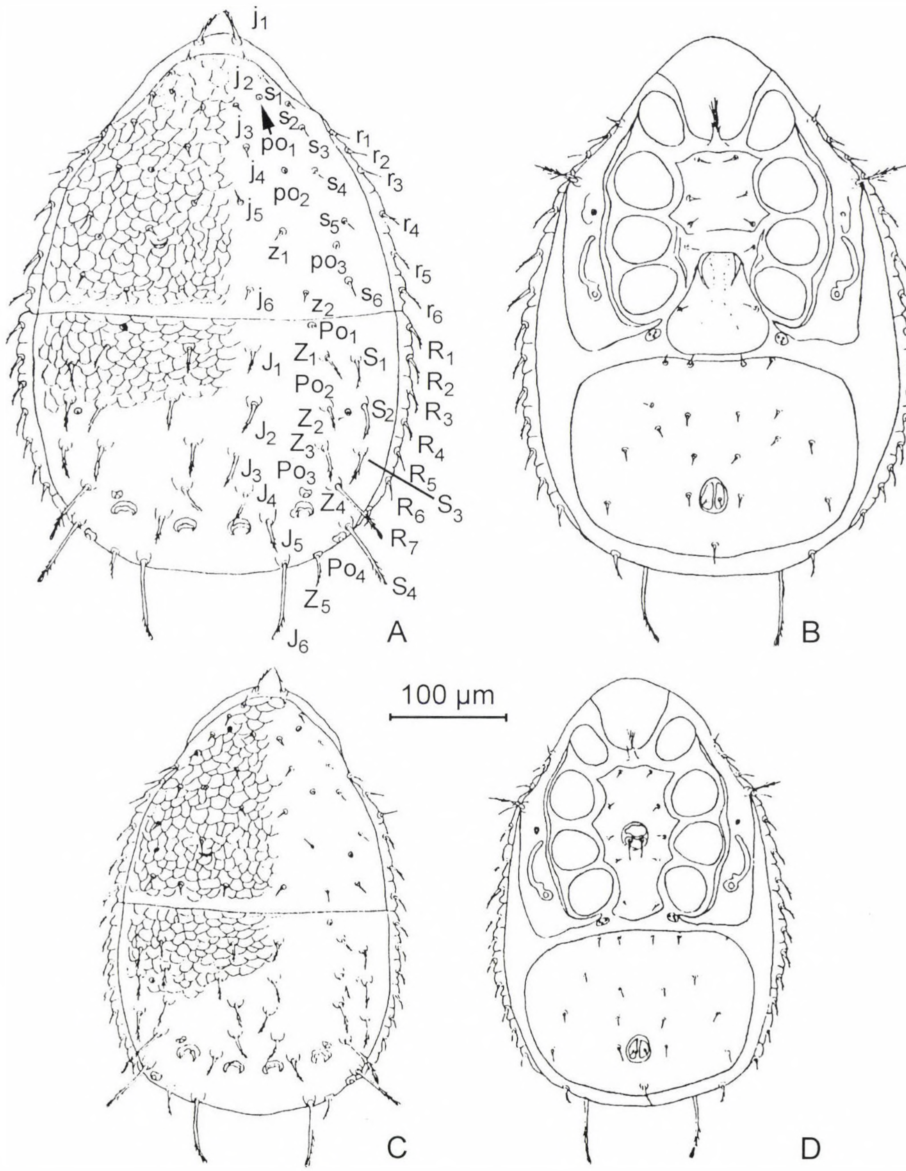


Fig. 1. *Zercon kackaricus* sp. n.: female: (A) dorsal idiosoma; (B) ventral idiosoma; male: (C) dorsal idiosoma; (D) ventral idiosoma

Table 2. Lengths and their mutual distances (M. dist.) of opisthonotal setae

Length	M. dist.	Length	M. dist.	Length	M. dist.
S_1–19 (17–20)	30 (27–31)	Z_1–16 (14–17)	34 (31–37)	J_1–16 (14–17)	34 (31–37)
S_2–28 (27–31)	31	Z_2–20 (17–21)	27 (24–28)	J_2–20 (17–21)	27 (24–28)
S_3–30 (27–31)	51 (48–54)	Z_3–30 (27–31)	34 (31–37)	J_3–25 (24–27)	26 (24–27)
S_4–52 (48–54)		Z_4–48 (44–31)	54 (51–58)	J_4–25 (24–27)	26 (24–27)
		Z_5–20 (17–21)		J_5–25 (24–27)	41 (37–44)
				J_6–60 (58–61)	

Diagnosis. The new species *Zercon kackaricus* sp. n. is closely related to *Z. colligans* BERLESE, 1920 and *Z. hispanicus* SELLNICK, 1958 (BERLESE 1920, SELLNICK 1958). The distinguishing characters among the three related species of the genus *Zercon* are given in Table 3.

Zercon delicatus sp. n.
(Figs 2 A–D)

Type material. Holotype ♀. "Turkey, Artvin, Yusufeli, Bahceli village, 1350 m, 20 September, 1992, collected by R. Urhan." Sample from moss pads underlying soil in a coniferous forest (mostly *Pinus* sp. and *Picea orientalis*). Paratypes: 30 ♀♀, 6 ♂♂; from the same sample; other paratypes from: Turkey, Artvin, Yusufeli, Cevreli village, 1550 m, 17 August, 1993, collected by R. URHAN. Sample from litter and soil underlying *Pinus* sp. in a mixed forest: 5 ♀♀, 4 ♂♂. Type deposi-

Table 3. The distinguishing characters among the three related species of the genus *Zercon*

	Z. colligans	*Z. hispanicus*	*Z. kackaricus* sp. n.
Setae J_1-J_2, Z_1-Z_2 and S_1	short, smooth	short, smooth	delicately barbed
Setae J_3-J_5, Z_3	barbed with hyaline ending	feathered	delicately barbed
Seta J_6	barbed with hyaline ending	feathered	barbed with hyaline ending
Seta Z_4	barbed with hyaline ending and not reaching posterior margin of ophistonotum	feathered and not reaching posterior margin of ophistonotum	barbed with hyaline ending and exceeding a third of its length posterior margin of ophistonotum
Anterior margin of ventro-anal shield	with two setae	with two setae	with four setae
Setae S_2 and S_3	barbed with hyaline ending	short, smooth	delicately barbed
Setae S_4	long, barbed with hyaline ending	long, feathered	long, barbed with hyaline ending

tion; holotype and 8 paratypes (5 ♀♀, 3 ♂♂) at the Zoological Museum of Atatürk University, Erzurum, Turkey. Other paratypes (30 ♀♀, 7 ♂♂) are deposited in the authors' collection

Female (Figs 2 A, B). Length of idiosoma (excluding gnathosoma) of holotype 520 µm, width 392 µm. Measurement of 35 paratypes; mean length 520 (507–538) µm, mean width 380 (357–398) µm.

Dorsal setae (Fig. 2A). On the podonotum seta j1 feathered the remainder short and smooth. On the opisthonotum setae J_1 and Z_1 short and smooth. Setae J_2–J_6 long, barbed with hyaline ending. Seta J_2 does not reach the base of seta J_3. Seta J_3 reaching to the base of seta J_4. Seta J_5 exceeding posterior margin of opisthonotum. Seta J_6 110 µm (on average) apart from each other. Setae Z_2–Z_4 long, barbed with hyaline ending. Seta Z_3 reaching to the base of seta Z_4. Seta Z_4 exceeding posterior margin of opisthonotum. Seta Z_5 long and smooth. The distance between setae Z_5–J_6 26 µm. Setae S_1–S_4 similar to seta J_6. Seta S_2 exceeding margin of opisthonotum. All marginal setae of opisthonotum short and smooth. Lengths and their mutual distances of opisthonotal setae are given in Table 4.

Table 4. Lengths and their mutual distances (M. dist.) of opisthonotal setae

Length	M. dist.	Length	M. dist.	Length	M. dist.
S_1–29 (27–31)	60 (58–65)	Z_1–18 (17–20)	66 (61–68)	J_1–17	64 (58–72)
S_2–42 (41–44)	60 (51–65)	Z_2–23 (20–24)	58 (51–61)	J_2–24	50 (48–54)
S_3–48 (44–51)	51 (44–58)	Z_3–14	42 (37–48)	J_3–36 (34–37)	36 (34–41)
S_4–48 (44–51)		Z_4–48	34 (31–41)	J_4–46 (44–48)	32 (27–34)
		Z_5–24 (20–27)		J_5–46 (44–48)	28 (24–31)
				J_6–52 (51–54)	

Pores. Pore po_1 located on the line connecting setae s_1–s_2. Pore po_2 on the line connecting setae j_4-s_4. Pore po_3 posterior to the line connecting setae z_1–s_5. Pore Po_1 located anterior to the insertion of seta Z_1. Pore Po_2 posterior to the line connecting setae Z_2–S_2. Pore Po_3 on the line connecting setae Z_4–J_4. Pore Po_4 on the line connecting setae S_4–Z_5.

Sculpturing pattern. The ornamentation of the dorsal shields shown in Fig. 2A. Dorsal cavities distinct, well sclerotized, equal in size with axes parallel to the body axis.

Venter (Fig. 2B). The chaetotaxy and shape of peritremal shield typical for the genus. Adgenital shields present with three pores. With four setae on the anterior margin of ventro-anal shield.

Male (Figs 2C, D). Idiosoma (excluding gnathosoma) in 10 specimens; mean length 405 (388–435) µm, mean width 283 (267–289) µm. Setae, pores and sculpture pattern on the podo- and opisthonotum as in female. The distance between setae J_6–J_6 and Z_5–J_6 avarage 92 µm and 20 µm, respectively. Lengths and their mutual distances of opisthonotal setae are given in Table 5.

Table 5. Lengths and their mutual distances (M. dist.) of opisthonotal setae

Length	M. dist.	Length	M. dist.	Length	M. dist.
S_1–22 (20–24)	43 (41–44)	Z_1–15 (14–17)	50 (44–58)	J_1–12 (10–14)	33 (41–51)
S_2–34	42 (37–44)	Z_2–17 (14–20)	37 (31–44)	J_2–16 (14–17)	40 (37–41)
S_3–40 (37–41)	40 (34–44)	Z_3–37	32 (31–34)	J_3–27 (24–27)	26 (20–27)
S_4–41		Z_4–43 (41–44)	32 (27–34)	J_4–32 (31–34)	22 (17–27)
		Z_5–16 (14–17)		J_5–32 (31–34)	25 (20–31)
				J_6–50 (48–51)	

Distribution. Artvin, Turkey.

Etymology. The specific ephithet refers to the delicate structure and setae of the idiosoma.

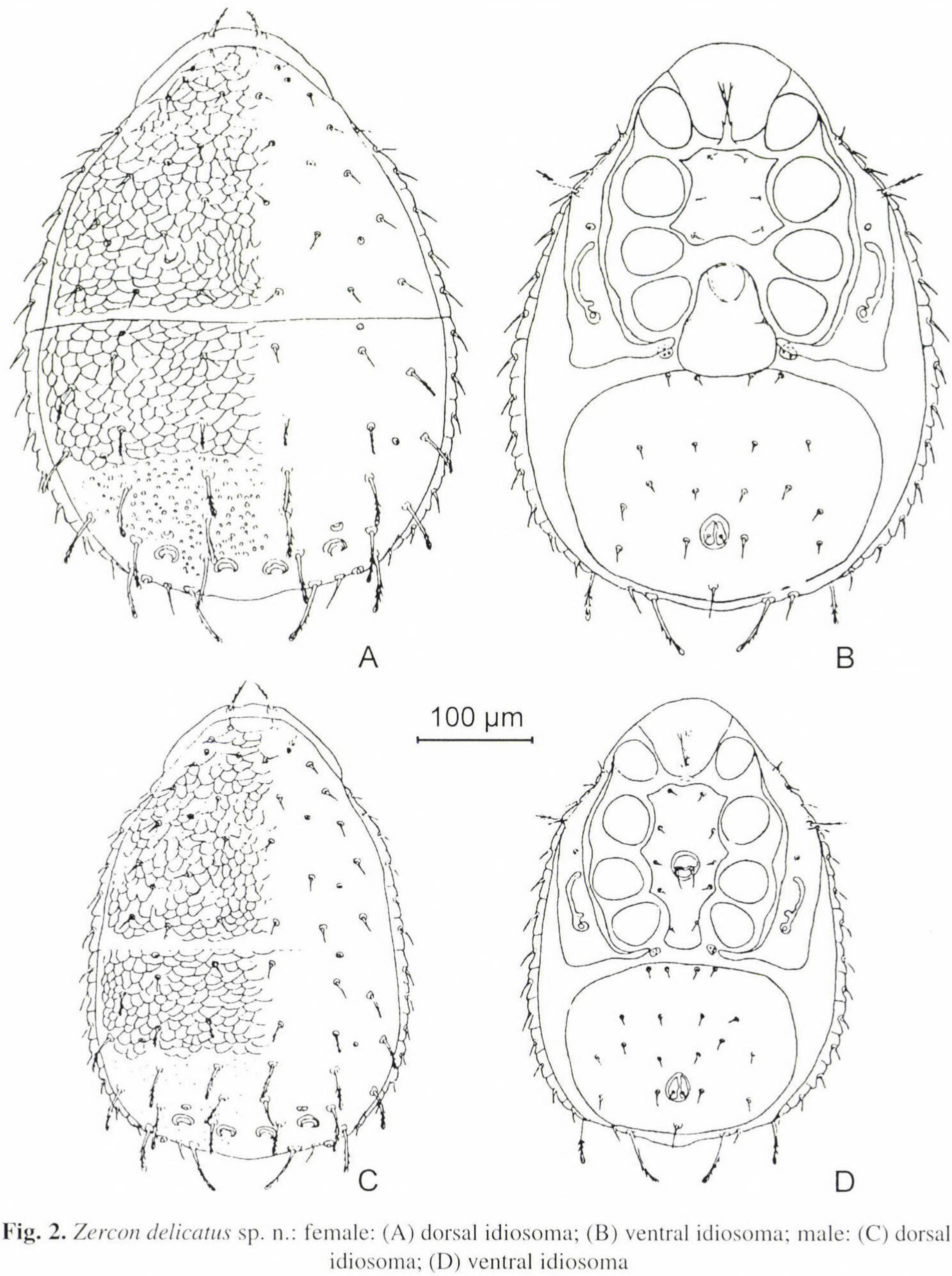


Fig. 2. *Zercon delicatus* sp. n.: female: (A) dorsal idiosoma; (B) ventral idiosoma; male: (C) dorsal idiosoma; (D) ventral idiosoma

Diagnosis. The new species *Zercon delicatus* sp. n. is closely related to *Z. kaszabi* BŁASZAK, 1978 and *Z. embersoni* BŁASZAK, 1985 (BŁASZAK 1978, 1985). The distinguishing characters among three the related species of the genus *Zercon* are given in Table 6.

Table 6. The distinguishing characters among the three related species of the genus *Zercon*

	Z. kaszabi	*Z. embersoni*	*Z. delicatus* sp. n.
Seate r_1–r_6	delicately barbed	delicately barbed	smooth
Setae J_1–J_3	short, barbed	seta J_1 short and smooth, seta J_2 delicately barbed and seta J_3 long, barbed with hyaline ending	seta J_1 short and smooth seta J_2 and J_3 long, berbed with hyaline ending
Setae Z_1 and Z_2	short, barbed	seta Z_1 short and smooth, seta Z_2 delicately barbed	setae Z_1 short and smooth, seta Z_2 long, barbed with hyaline ending
Seta Z_5	delicately barbed	delicately barbed	smooth
All marginal setae of opisthonotum	delicately barbed	delicately barbed	smooth
Pore Po_3	on the line connecting setae Z_3–Z_4	on the line connecting setae Z_4–J_4	on the line connecting setae Z_4–J_4
Seta J_5	exceeding posterior margin of opisthonotum	not reaching posterior margin of opisthonotum	exceeding posterior margin of opisthonotum
The sculpture of posterior part of opisthonotum	delicately and finely maculate	smooth	covered with distinct spots

KEY TO THE ADULTS OF THE GENUS ZERCON KNOWN FROM TURKEY

1	Anterior margin of ventro-anal shield with two setae	2
–	Anterior margin of ventro-anal shield with four setae	12
2	The long setae of opisthonotum with hyaline ending	3
–	The long setae of opisthonotum without hyaline ending	10
3	Setae J_4–J_5 delicately barbed or with hyaline ending	6
–	Setae J_4–J_5 smooth	4

4	Seta S_2 with hyaline ending	*solenites* HAARLOV, 1942
–	Seta S_2 smooth	5
5	Seta S_3 smooth	*lepurus* BŁASZAK, 1979
–	Seta S_3 with hyaline ending	*separatus* URHAN, 2001
6	Setae J_4–J_5 delicately barbed	7
–	Setae J_4–J_5 with hyaline ending	8
7	Seta S_2 delicately barbed and without hyaline ending	*fragilis* URHAN, 2001
–	Seta S_2 with hyaline ending	*nemoralis* URHAN, 2001
8	Seta S_3 not reaching margin of opisthonotum	*colligans* BERLESE, 1920
–	Seta S_3 reaching margin of opisthonotum	9
9	Seta J_3 with hyaline ending	*plumatopilus* ATHIAS-HENRIOT, 1961
–	Seta J_3 smooth	*insperatus* BŁASZAK, 1979
10	Pores Po_3 on the line connecting setae Z_4–J_5, seta Z_4 not reaching posterior margin of opisthonotum	*ignobilis* BŁASZAK, 1979
–	Pores Po_3 anterior to the line connecting setae Z_4–J_4, seta Z_4 reaching posterior margin of opisthonotum	11
11	Seta j_2 short and smooth	*adoxyphes* BŁASZAK, 1979
–	Seta j_2 long and barbed	*caucasicus* BŁASZAK, 1979
12	Between the setal rows J–J and J–Z eight extra setae	*trabzonensis* URHAN, 1997
–	Between the setal rows J-J and J-Z no extra setae	13
13	Setae J_4–J_5 smooth	14
–	Setae J_4–J_5 delicately barbed or with hyaline ending	23
14	Seta S_3 absent	*beleviensis* URHAN, 2001
–	Seta S_3 present	15
15	Seta S_3 delicately barbed	*serratus* URHAN, 2001
–	Seta S_3 smooth or with hyaline ending	16

16	Setae S_3 and S_4 with hyaline ending	17
–	Setae S_3 and S_4 smooth	19
17	Seta Z_3 short and smooth	*ozkani* URHAN et AYYILDIZ, 1994
–	Seta Z_3 long and with hyaline ending	18
18	Seta S_2 short and smooth	*pinicola* HALASKOVA, 1970
–	Seta S_2 long and with hyaline ending	*andrei* SELLNICK 1958
19	Long setae of opisthonotum thick and terminally broad	*berlesei* SELLNICK, 1958
–	Long setae of opisthonotum thin and smooth	20
20	Seta S_3 exceeding the margin of opisthonotum	21
–	Seta S_3 not reaching the margin of opisthonotum	*perforatulus* BERLESE, 1904
21	Pores Po_3 between setal rows J–Z and the outer dorsal cavities twice bigger than inner cavities	22
–	Pores Po_3 between setal rows Z–S and the dorsal cavities equal in size	*montanus* WILLMANN, 1943
22	Seta J_3 not reaching the bases of seta J_4	*cayblus* ATHIAS-HENRIOT, 1961
–	Seta J_3 reaching the bases of seta J_4	*bulgaricus* BALOGH, 1961
23	Pores Po_3 between setal rows Z–S	*notabilis* BŁASZAK, 1979
–	Pores Po_3 between setal rows J–Z	24
24	Setae J_4–J_5 delicately barbed	25
–	Setae J_4–J_5 with hyaline ending	26
25	Setae S_2 and S_3 delicately barbed	**kackaricus** sp. n.
–	Setae S_2 and S_3 with hyaline ending	*septemporus* URHAN, 2001
26	Seta J_3 short and smooth	*burdurensis* URHAN 2001
–	Seta J_3 long and with hyaline ending	27
27	Seta S_1 smooth	*quadricavum* URHAN, 2001

–	Seta S_1 delicately barbed or with hyaline ending	28
28	Seta S_1 delicately barbed	*turcicus* URHAN et AYYILDIZ, 1994
–	Seta S_1 with hyaline ending	29
29	Setae R_1–R_7 smooth	**delicatus** sp. n.
–	Setae R_1–R_7 delicately barbed or with hyaline ending	30
30	Setae R_1–R_7 delicately barbed	*apladellus* BŁASZAK, 1979
–	Setae R_1–R_7 with hyaline ending	31
31	Setae J_1 and Z_1 with hyaline ending	*ayyildizi* URHAN, 1997
–	Setae J_1 and Z_1 smooth	32
32	Setae J_5 and Z_4 not reaching posterior margin of opisthonotum	*agnostus* BŁASZAK, 1979
–	Setae J_5 and Z_4 reaching posterior margin of opisthonotum	*salmani* URHAN, 2001

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The oribatid species described by Berlese (Acari)

by MAHUNKA, S. and L. MAHUNKA-PAPP

The authors had the opportunity for years to study the Oribatid species described by Berlese currently deposited in the Istituto Sperimentale per la Zoologia Agraria at Florence. The results of this series of studies are summarized in this volume.

The volume begins with an essay-like Introduction heavily relying on subjective opinions discussing the general questions of Oribatology. The following section lists Berlese's species placed in the modern system helping the specialists with morphological notes and many drawings; here also the condition of the specimens is discussed and lectotypes are designated.

The third, large section is the catalogue proper, wherein all the species are listed in the systematic order together with their combination and synonymic names. Here one may find all the literature data, usually missing from ordinary works, with reference to Description and Taxonomy, Distribution, with special emphasis on Catalogues whose references are partly unreliable. Where it was deemed necessary further information are added under the heading of Remarks. The volume closes with a very detailed list of literature.

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IDENTIFICATION OF HUNGARIAN MUSTELIDAE AND OTHER SMALL CARNIVORES USING GUARD HAIR ANALYSIS

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The characteristics of the guard hairs of all the mustelids in Hungary and *Vulpes vulpes* and *Felis silvestris* were examined for diagnostic characters. The analysis of hair samples taken from guts, scats, burrows, nests and bait sites can serve as an easy and quick method for faunistic research. The difficulties of hair determination are the similar appearance, overlapping characters and often the low number of samples, but some relevant characters of hair could be used to develop more detailed and specific identification. Otter and Badger differ markedly from the other mustelids while separating the hair of the other six species living in Carpathian Basin (Polecat, Steppe Polecat, Stoat, Weasel, Pine Marten and Stone Marten) demanded statistical analysis. Separating the two "twin-pairs" of species (Stoat and Weasel, Polecat and Steppe Polecat) is not probable by this technique.

Key words: small carnivores, Mustelidae, hair, identification, Carpathian Basin

INTRODUCTION

There are eight species of Mustelidae in the Carpathian Basin, all indigenous: Weasel (*Mustela nivalis*), Stoat (*Mustela erminea*), Polecat (*Mustela putorius*), Steppe Polecat (*Mustela eversmannni*), Stone Marten (*Martes foina*), Pine Marten (*M. martes*), Badger (*Meles meles*) and Otter (*Lutra lutra*). The European Mink (*Mustela lutreola*) is only a rare, lonely rambling (UJHELYI 1994). Mustelids are regarded as important top predators, because the Wolf (*Canis lupus*) and Lynx (*Lynx lynx*) are scarce, though their gradual return to the fauna is occurring through to their natural re-expansion. Although these sympatric carnivores prefer different habitats and foods, they often share the same area. Earlier publications have shown a lack of reliable information about the occurrence, home range, the population dynamics, distribution trend of these species (BÁLDI *et al.* 1995, DEMETER 1984). It is also important to note that the ecological drivers change for these species, as does the extent and general perception of damage caused by them. In recognition of these problems monitoring projects were initiated with the objective of facilitating the development of appropriate protection and management practices. The gradation of some Rodentia may cause the increase of small carnivores (SZEMETHY *et al.* 2000). The proceeding surveys used the methods of live-trapping with the food

analysis from scats and stomach contents (LANSZKI *et al.* 1999). Valuable information obtained from hunters in the study region was also incorporated. Preliminary results indicate an increase in the number and range of *Meles meles* and *Martes foina*. Both of them frequent the rural as well as the urban environment. Badgers will steel eggs and chickens of partridges and pheasants fledglings and often rifle the maize-fields (SZEMETHY *et al.* 2000). Stone Martens find its food and make dens in urban environment perfectly (TÓTH 1998, 2000). Data are most limited and inconclusive on the *Mustela eversmanni, M. erminea* and *Martes martes*. All of them have disjunct populations within Hungary area. Their damage caused is rather neglible, even though Pine Marten often pillage the nest of protected tree nesting birds. *Mustela eversmanni, M. erminea* and *Martes martes* are protected. *Lutra lutra* has strictly protected status in Hungary. Thanks to successful protection and management programs and natural distribution, the number of Otters has been increasing (Gera 1998). Other Hungarian small carnivores populating the Carpathian Basin are Red Fox (*Vulpes vulpes*), Jackal (*Canis aureus*), Racoon Dog (*Nyctereutes procyonides*) and Wild cat (*Felis silvestris*). They often occupy each others' abandoned burrows. Hair traces and other tracks left behind can reveal the identity of the occupants. Jackal, Racoon Dog and the recently emerging, adventurous Racoon have coarse, long guard hair with black or dark brown marks at the tip and the base. Thus this study only covered the comparative analysis of the Wild Cat and Red Fox, and does not address the problem of incorrect identification as a result of mistaken domestic cat (*Felis catus*), dog (*Canis familiaris*), feral (*Mustela furo*) or their hybrids.

The three layers of the hair are the cuticula, cortex and the medulla. Their morphological characters may provide data for statistical analysis. Intact guard hair can yield a lot of valuable information. According to international experience it is the adults' dorsal guard hair that reveal the most clues. There can be, however, significant variations that occur as a function of the age of the hair sample, the part of the body the sample originates from, the age and condition of the animal and season. As a consequence, analysis based on one or a few samples will only provide a limited level of confidence. It is still being debated whether hair characteristics are distinct enough to play a role in taxonomy. It is recognised however that some parameters or their combinations show specific or generic trends and often reveal genetic, phylogenetic and other morphometric information (KENNEDY 1982, CHAKRABORTY 1998, MCDANIEL 2000, MOWAT & STROBECK 2000). The objective here is to develop keys to the identification of mustelids living in the Carpathian Basin through hair analysis, while also identifying overlapping characters which may lead to the incorrect identification of species.

MATERIALS AND METHODS

Hairs were gathered mainly from specimens deposited in the Department of Zoology of the Hungarian Natural History Museum. The fundamental selection criteria were species identity and source of collection. Specimens derived from different parts of Hungary. The study series included a minimum of five individuals of each species with 20 randomly selected guard hair samples taken from each individual. This brought the number of samples for each species to 100.

The samples were cleaned in 60% alcohol then ether to free them of grease and dust. The cuticular preparations were made in about 20% gelatine with thymol preservative. Canada balm was used for the permanent medullar slides. The applied methods and the nomenclature of cuticular, medullar and cross-section patterns were based mainly on TEERINK (1991). Some relevant expressions were also adopted from MOORE *et al.* (1974).

Macro- and microscopic investigations were carried out on the samples using sections and impressions. The standard magnification of photographs was 400 times. The measurements were taken by ocular micrometer or using Windows Winimag in order to get more precise results in micrometer. The resulting data were then used to develop quantitative and qualitative keys of identification.

Due to the relatively small number of samples, the frequent occurrence of extreme values and high variances it was decided to use SPSS Non-parametrical, independent statistics. The SPSS Hierarchical Cluster Analysis was used to develop Dendrograms representing Average Linkage as a function of length (l), maximal diameter (d), medulla/total, maximal diameter ratio at thickest part of shield (m/d) between the ten small carnivore species investigated. The Mann–Whitney statistical test was used to compare the mean value of characters.

Qualitative analysis of characteristics

Qualitative data descriptive characteristics were used:

- The colour of the tip: MOORE *et al* (1974) defined the tip as the opposite of the basal part of hair, KENNEDY (1981) interpreted it as the region most distal from the basal part of the hair and has one proximal colour demarcation. TEERINK (1991) used the expression ‘tip’ mainly for the most distal zone from the base without medulla. The exact measurement of length of this region is difficult, because it often shows a gradual transition, nevertheless, colour is regarded important.
- The number of bands. MOORE *et al.* (1974) defined the band as the region of the hair that shows distinct proximal and distal colour bands.
- The pattern of cross- section of thickest part of shield. The methods were given previously (MATHIAK 1938, KENNEDY 1981, TEERINK 1991). Making cross-sections is a problem since the exquisite fixation of hair is difficult. Hair often curve, giving deformed contours, so require a lot of samples and cutting. Another method was probed fitting the hair in the middle of elderpith or other flexible twigs. After freezing (or without it) samples were cut by razors. This method has the same problem but easy to apply for field works.
- The pattern of cuticula and medulla of shaft (the proximal part of the hair = near to the base of hair).
- The pattern of cuticula and medulla in the transitional part between the shaft and shield.
- The pattern of cuticula and medulla in the shield (the distal part of the hair = near to the tip of hair).

Table 1. Descriptive characteristics of hair of mustelids and mistakable species (Red Fox and Wild Cat). (The denomination of "Brown" mean the different tints of this colour may occur at every species included: the greyish, reddish and tawny tints)

Species	Colour of the hair	Colour of tip	Colour of base	No. bands	Cuticula of shaft	Cuticula of transitional part	Cuticula of shield	Medulla of shaft	Medulla of transitional part	Medulla of shield	Medullar margins	Cross-section
1. *Mustela erminea*	Brown	Brown	Brown	0	Pectinate and diamond petal	Regular distant wave and mosaic (Fig. 3)	Close, regular wave	Unicellular ladder (Fig. 5)	Irregular unicellular ladder	Cloisonné	Scalloped	Oval or oblong
2. *Mustela nivalis*	Brown	Brown	Brown	0	Pectinate and diamond petal	Mosaic and elongate petal	Irregular or regular wave	Unicellular ladder	Unicellular, irregular ladder	Cloisonné	Scalloped (Fig. 6)	Oval or oblong
3. *Mustela eversmanni*	Brown	Black, dark brown	Yellow, white, light-brown	0	Pectinate (Fig. 1) and diamond petal	Mosaic	Irregular or regular wave	Unicellular ladder	Irregular uni-, or multicellular	Cloisonné	Scalloped	Oblong
4. *Mustela putorius*	Brown	Black, dark-brown	White, light-brown	0	Diamond petal	Mosaic	Irregular or regular wave	Unicellular ladder	Irregular multicellular	Cloisonné	Scalloped	Oblong
5. *Martes martes*	Brown	–	–	0	Diamond petal	Mosaic	Mosaic and close, regular wave	Unicellular ladder	Irregular multicellular	Cloisonné	Scalloped	Oval or oblong
6. *Martes foina*	Brown	Brown	Brown	0	Diamond petal	Mosaic and regular wave	Close, regular wave	Unicellular ladder	Multicellular	Cloisonné (Fig. 7)	Scalloped	Oval or oblong
7. *Meles meles*	White with black or dark-brown band	White	White	1	Intermediate regular wave	Regular wave and mosaic	Close, regular and irregular wave	Amorphous	Amorphous	Amorphous with differently shaped cells	Straight or fringed-like	Oblong

Table 1 (continued)

Species	Colour of the hair	Colour of tip	Colour of base	No. bands	Cuticula of shaft	Cuticula of transitional part	Cuticula of shield	Medulla of shaft	Medulla of transitional part	Medulla of shield	Medullar margins	Cross-section
8. *Lutra lutra*	Brown, rarely white or light-brown with a brown band in the shield	Light-brown, rarely white	Light-brown, rarely white	0–1	Pectinate and diamond petal (Fig. 2)	Broad petal, irregular wave and mosaic	Close, regular wave (Fig. 4) and petal	Irregular unicellular ladder	Unicellular ladder with wide cells	Wide unicellular	Straight or scalloped	Elongated oblong
9. *Vulpes vulpes*	Brown with white band	Fulvous, brown	Black, dark-brown	0–1	Broad petal and mosaic	Irregular wave	Close, irregular wave	Multicellular ladder	Irregular multicellular ladder	Cloisonné-like with rounded or oval cells (Fig. 9)	Straight,or fringed	Rounded
10. *Felis silvestris*	Brown with bands, bands are white, yellow or brown	Dark-brown	Dark-brown	0–1–2	Regular wave and mosaic	Mosaic and regular wave	Close, irregular wave	Irregular, uni-multi-cellular	Irregular uni-multi-cellular	Irregular mulicellular with narrow spindle-like or large cells	Fringed (Fig. 10) or scalloped	Rounded or oblong

Table 2. The length (l), maximal diameter at shield (d) and ratio of medulla and diameter at shield (m/d) of the studied small carnivores (the given l, d and m/d values are mean value of 20 hairs of the same specimens)

Mustela	*erminea*	*nivalis*	*erminea*	*nivalis*	*erminea*	*nivalis*
	l	l	d	d	m/d	m/d
1.	15	7	110	110	0.7	0.8
2.	22	6	115	92.5	0.787	0.772
3.	9.5	9	117.5	87.5	0.79	0.71
4.	9	8	92.5	92.5	0.804	0.78
5.	14	10	97.5	100	0.77	0.7
Mean	13.9	8	106.5	96.5	0.7702	0.7524
Variance (sd)	5.24880	1.58113	10.9829	8.76783	0.04106	0.04459
Mustela	*eversmanni*	*putorius*	*eversmanni*	*putorius*	*eversmanni*	*putorius*
	l	l	d	d	m/d	m/d
1.	35	45	82.5	120	0.742	0.71
2.	38	37	112.5	130	0.69	0.7
3.	36	30	100	90	0.7	0.785
4.	45	40	115	142.5	0.91	0,.6
5.	42	41	87.5	135	0.8	0.78
Mean	39.2	38.6	99.5	123.5	0.7684	0.747
Variance (sd)	4.20713	5.59464	14.5129	20.4328	0.09023	0.03962
Martes	*martes*	*foina*	*martes*	*foina*	*martes*	*foina*
	l	l	d	d	m/d	m/d
1.	35	40	80	120	0.6	0.6
2.	37	45	90	90	0.878	0.71
3.	45	50	120	125	0.628	0.753
4.	38	45	82.5	125	0.86	0.69
5.	40	38	112.5	120	0.875	0.7
Mean	39	43.6	97	116	0.7682	0.6906
Variance (sd)	3.80788	4.72228	18.1486	14.7478	0.14127	0.05605
Meles/Lutra	*M. meles*	*L. lutra*	*M. meles*	*L. lutra*	*M. meles*	*L. lutra*
	l	l	d	d	m/d	m/d
1.	60	28	250	120	0.6	0.56
2.	86	26	200	70	0.45	0.6
3.	90	20	167.5	160	0.45	0.68
4.	45	18	175	110	0.43	0.66
5.	60	25	187.5	90	0.46	0.694
Mean	68.2	23.4	196	110	0.478	0.6388
Variance (sd)	19.1363	4.21900	32.6247	33.9116	0.06906	0.05680

Vulpes/Felis	*V. vulpes*	*F. silvestris*	*V. vulpes*	*F. silvestris*	*V. vulpes*	*F. silvestris*
	l	l	d	d	m/d	m/d
1.	55	45	85	100	0.7	0.72
2.	37	52	90	60	0.82	0.7
3.	60	35	120	120	0.78	0.73
4.	25	60	120	92.5	0.75	0.75
5.	50	30	117.5	80	0.65	0.7
Mean	45.4	44.4	106.5	90.5	0.74	0.72
Variance (sd)	14.2583	12.2188	17.4642	22.3886	0.06670	0.02121

All the descriptive characteristics of the ten species investigated necessary for further identification are included in Table 1.

Quantitative analysis of characteristics

Quantitative data, statistical characteristics were used:

- The length of guard hairs (l), the mean of length and the variance of length.
- The diameter (d) of thickest part of shield (distal part of the hair = toward the tip), the mean and the variance of it.
- Medullary index: the ratio of medulla (m) and total diameter (d) in the thickest part of shield (m/d), the mean value and variance. TEERINK (1991) used the CC/TW (cuticle-cortex/total width) ratio, but instead of this I use the medullary index (medulla/ total width) as DEBROT (1982) and CHAKRABORTY *et al.* (1999), because the width of cuticula-cortex may vary around the given section of the medulla.

All the necessary data that were measured are in Table 2. These data served the base matrix of non-parametrical statistical tests, and the results of these tests are shown in Table 3. These test were made on the easily confused species, like the Stoat and Weasel, the Polecat and Steppe Polecat, the Stone Marten and Pine Marten.

Table 3. Results of non-parametric Mann–Whitney test on the basis of pairs of species have overlapping characters

	l: Mu.er.-Mu.ni.	d: Mu.er.-Mu.ni.	m/d: Mu.er.-Mu.ni.	l: Mu.ev.-Mu.pu.	d: Mu.ev-Mu.pu.	m/d: Mu.ev.-Mu-pu.	l: Ma.ma. - Ma.fo.	d: Ma.ma. -Ma.fo.	m/d: Ma.ma. -Ma.fo.
Mann–WhitneyU	2.50	5.50	9.50	12.50	3.00	12.50	5.00	3.50	8.50
Wilcoxon W	17.5	20.5	24.5	27.5	18.00	27.50	20.00	18.50	23.50
Asymp. sig. (2-tailed)	0.036	0.138	0.53	1.00	0.047	1.00	0.110	0.055	0.402
Exact sig. [2*(1-tailed sig.)]	0.032	0.151	0.548	1.00	0.056	1.00	0.151	0.056	0.421

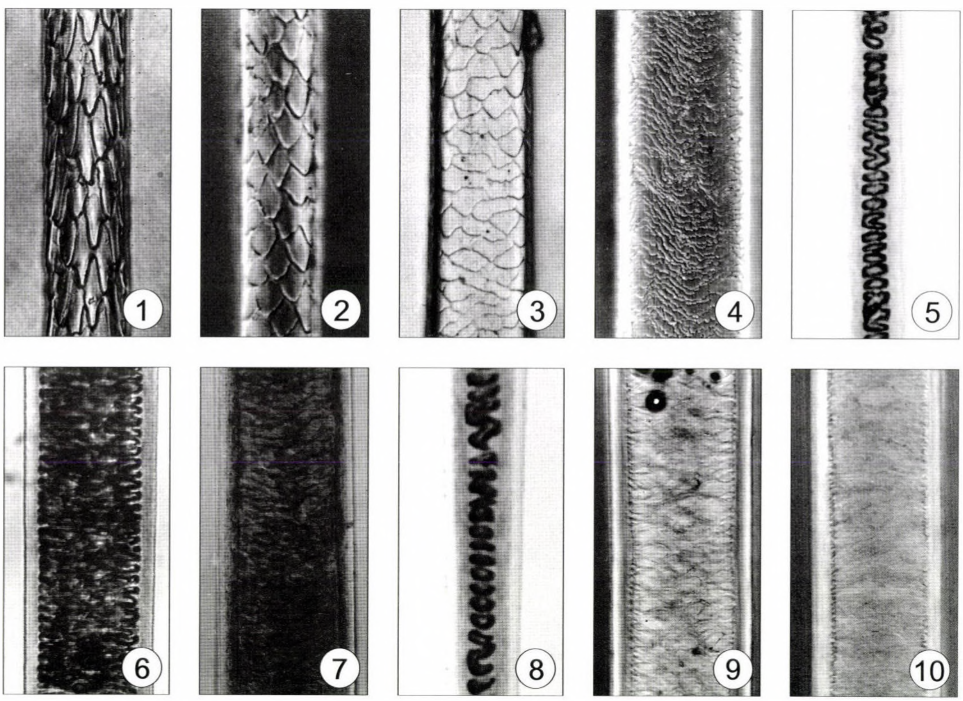
Results show that significant differences (at $p = 0.05$) are very rare. *Mustela erminea* and *M. nivalis* show significant differences only in length, the Stoat's guard hair being longer. *Mustela putorius* and *M. eversmanni* show some differences at maximum diameter: wider in Polecat. The *Martes foina* and *M. martes* differ in maximum diameter, the Stone Marten having a wider diameter at the thickest part of the shield. Cluster analysis of length, maximum diameter and medullary index of all species shows, that even these little differences can give some points of branching that may be used for identification.

DISCUSSION

Previous publications (MOORE *et al.* 1974, DEBROT 1982, BLAZEJ 1989, TEERINK 1991) have indicated the most important features of hairs that are required for identification but they used often a different nomenclature for patterns and did not give statistical descriptions. Some deviations of quantitative characteristics may be connected with the different geographic habitat within the area of the given species. CHAKRABORTY *et al.* (1999) could use the differences in Side-to-side cuticular scale length (SS) and Proximo-distal cuticular scale length (PD) for segregating the lesser Indian cats, the genus *Panthera* and Mongoose species. These measurements were carried out for Mustelidae, but in this case the variance and overlap were too high to use them as identification keys. Measurements on length, diameter and ratio of medulla-maximal diameter have shown high variance, and may vary within the same individual. Multiplying the samples could not reduce the high variance while the mean value proved to be standard, so these parameters were not relevant for distinguishing mustelids. TEERINK (1991) described the so-called mustelid-like characters as it having diamond petal cuticula (Fig. 2) of shaft, cloisonné (Fig. 7) pattern of medulla and scalloped margin of medulla (Fig. 6) of shield region. These patterns appear in Red Fox while they are absent in Badger and Otter. Analysis has shown that only the combinations of certain sequences and ratios are relevant for identification. The "mustelid-like" characters considering only the subfamily of Mustelinae are:

- hairs have no bands;
- medullary index: $m/d = 0.7–0.8$;
- the sequences of cuticular patterns from the base to the tip: transitional, regular mosaic – pectinate (Fig. 1) – diamond petal (Fig. 2) – mosaic (Fig. 3) – regular or irregular wave (Fig. 4),
- the sequences of medullar patterns from the base to the tip: unicellular ladder (Fig. 5) – unicellular, irregular ladder – cloisonné (Fig. 7) – fragmented (Fig. 8).

Mustela erminea and *M. nivalis*: TEERINK (1991) distinguished *M. erminea* and *M. nivalis* based on differences of the total length and the different number of bulges protruding into the cortex within a certain section. Stoat and weasel cannot be distinguished with a high level of confidence, except maybe on the basis of the length of hair. The mean length of Stoat's hairs are about 14 mm (sd = 5.2), Weasel's hairs are about 8 mm (sd = 1.6). All other qualitative or quantitative data show total overlap as shown in Table 3. Meanwhile they compose an isolated group within the mustelids, because of short, homogenous brown hairs (not including the white, winter hairs of Stoat) and the shield region of hair is markedly widened after the narrow shaft while smoothly thicken of other mustelids. *Martes foina* and *M. martes* have the same patterns but guard hairs are much more longer. Some shorter hairs of *Lutra lutra* may be similar to these species, but the medullar characters are different.



Figs 1–10. Photographs of small carnivores guard hairs: 1 = pectinate pattern of cuticula (*Mustela eversmanni*); 2 = diamond petal pattern of cuticula (*Lutra lutra*); 3 = mosaic pattern of cuticula (*Mustela erminea*); 4 = regular, close wave pattern of cuticula (*Lutra lutra*); 5 = unicellular ladder pattern of medulla (*Mustela erminea*); 6 = scalloped margin of medulla (*Mustela erminea*); 7 = cloisonné pattern of medulla (*Martes foina*); 8 = fragmented medulla (*Mustela erminea*); 9 = cloisonné-like medulla with straight medullar margin and large, oval cells (*Vulpes vulpes*); 10 = multicellular medulla with fringed medullar margin and spindle-like cells (*Felis silvestris*)

Martes foina and *M. martes:* We can separate *Martes foina* and *M. martes* on the basis of the structure of medulla. As described by TEERINK (1991), the medullar cells lie perpendicular to the cortex in the case of Pine Marten, but lie obliquely Stone Marten. This mark is not always visible, statistically the mean value of length, maximal diameter and medullary index have shown some differences (Table 3). Stone Marten has significantly wider diameter at the shield, d = 116 (sd = 15), while d = 97 (sd = 18) of the Pine Marten. The mean value of medullary index, m/d = 0.6–0.75 of the Stone Marten, but m/d often exceeds the 0.8 of the Pine Marten.

Mustela putorius and *M. eversmanni*: Previous publications did not give a description of hair of *M. eversmanni*. This study has pointed out that *Mustela putorius* and *M. eversmanni* can only be distinguished statistically based on the value of the diameter: Polecat's diameter significantly wider at the shield, mean value d = 124 (sd = 20), while mean value of maximal diameter, d = 100 (sd = 15) of the Steppe Polecat (Table 3). The basal and shaft part of hair more often yellow than white in case of Steppe Polecat.

Lutra lutra: The fine, thin homogenous brown hair has a lighter zone at the base and at the tip, some guard hairs may have bands as brown hairs with one white band or light-brown, white hairs with one brown band. The mean length about 23 mm (sd = 4.22). The medullary index about 0.6–0.7. Medulla at shield has cells reaching across the total width, so instead of the mustelid-like cloisonné we find mainly the unicellular unbroken pattern and straight or scalloped margins. The cross-section is elongated oblong. The cuticular patterns are regular and close. Some shorter guard hairs of Stone Marten may resemble Otter's hair but the medullar configurations have relevant differences.

Meles meles: Badger is unique among the Mustelidae, significant characters give keys for identification. The long, straight, strong hairs have a white tip and base, so even the external characters make exact identification possible. Otherwise, every internal characters are different. The mean length 68 mm (sd = 19). The mean maximal diameter of shield 196 µm (sd = 33). The medullary index about 0.5. That value show significant deviation from the other small carnivores where m/d values are about 0.7. "Mustelid-like" diamond petal of cuticle at shaft section, the cloisonné pattern and scalloped margins of medulla at thickest part of shield are absent. The cuticular patterns are mostly transverse, regular waves, margin of the medulla mostly straight or rarely fringed, the medulla is amorphous, with some large, rounded or oval cells.

Mistakable characters of hair of *Vulpes vulpes* and *Felis silvestris*: There are some brown hairs which have light-yellow or brown or fulvous shaft and dark-brown shield with overlapping parameters: the length (approximately 40 mm), diameter (approx. 100 µm) and medullary index (approx. 0.75). These hairs may orig-

inate from the coat of Martens, Polecats, Red Fox or rarely the Wild Cat. Important factors distinguishing these species are the characters of medulla. The medullar margin at the shield is straight or fringed in Red Fox; fringed (Fig. 10) or rarely scalloped in Wild Cat, but typically scalloped (Fig. 6) in Polecats, Martens. The cloisonné pattern of medulla is typical in Polecats and Martens. The multicellular, "cloisonné-like" pattern of Red Fox and Wild Cat are really similar, but the medulla of Red fox (Fig. 9) contains rounded or oval cells against the mostly spindle-like or large cells in Wild Cat. Taking into consideration that most of the Wild Cat's guard hairs have at least one band and the petal pattern of shaft is absent, this species differs significantly from the other investigated small carnivores.

IDENTIFICATION KEYS TO GUARD HAIRS OF MUSTELIDAE LIVING IN CARPATHIAN BASIN AND TO RED FOX AND WILD CAT

1a Hair have bands 2

1b Hair homogenous brown, or show a gradual transition from light to dark shades 6

2a The colour of the tip and base are white or light 3

2b The colour of the tip and base are dark, brown or black, the number of light (white, yellow) bands one or two 4

3a The colour of the tip and base are white, the colour of the band is black or dark-brown. The length of hairs are 60–90 mm. The mustelid-like diamond petal-pectinate scale pattern at the shaft and the medullary cloisonné pattern at shield region are absent. The medullary index (m/d) about 0.5 *Meles meles*

3b The colour of the tip and base are white or light-brown, the colour of the band is brown, reddish. The length of hair is 18–28 mm. The cuticular pattern of base are regular, close diamond petal and pectinate but cloisonné pattern of medulla at shield is absent *Lutra lutra*

4a The length of hair is 18–28 mm, only one band counted. The medullary index mainly about 0.6. Cross-section of hair is elongated-oblong *Lutra lutra*

4b The mean length of hair about 45 mm (sd = 12–14). Number of bands one or two. Medullary index about 0.6–0.7. Cross-section often rounded or oblong 5

5a Banded hair are tricoloured: the base often fulvous, the middle part yellow or white and the shield and tip regions are black, dark-brown. The cuticle of shaft has broad petal or mosaic pattern. The margin of medulla at thickest part straight or fringed, the medullar pattern cloisonné of shield, the cross-sections of hair rounded at total length. Guard hair without band are brown or fulvous at base and than turn into black markedly, the base never white or yellow (as Polecats) *Vulpes vulpes*

5b There are two type of banded hair. Hair with one band are black or dark-brown with a yellow or white section in the middle part. Hair with two bands has a white or yellow base, then a black, then a white section towards the black tip. The cuticular pattern of the base is mainly mosaic or regular wave. The margin of the medulla at thickest part of shield is fringed or scalloped. The cross-section is rounded or oblong. Medullar configuration at shield is cloisonné-like or unbroken, with spindle-shaped or wide cells *Felis silvestris*

6a Colours of hair show a gradual transition from light to dark tints, the colour of base and tip are different. Usually the transitional, middle part yellow at Steppe Polecat while white or grey-yellow at Polecat. Significant differences derive only on the diameter of these species

6a.1 Mean value of maximal diameter d = 123.5 (sd = 20.4) *Mustela putorius*

6a.2 Mean value of maximal diameter d = 100 (sd = 14.5) *Mustela eversmanni*

6b Hair homogenous brown, or have only slight difference 7

7a Length of hair usually not longer than 15–20 mm, but often shorter. The shaft thin, light, the shield widening-flat. These species are Stoat and Weasel. It has significant differences only at mean length of hair

7a.1 Mean value of length l = 14 (sd = 5.2) *Mustela erminea*

7a.2 Mean value of length l = 8 (sd = 1.6) *Mustela nivalis*

7b Length of hair about 35–50 mm. Medullary index about 0.7. Hairs are brown, fulvous or rarely dark-grey 8

8a Mean value of maximal diameter d = 97 (sd = 18), the medullary index m/d = 0.77 (sd = 0.14), often bigger than 0.8. Hair are mainly brown or fulvous *Martes martes*

8b Mean value of maximal diameter d = 116 (sd = 15), the medullary index m/d = 0.7 (sd = 0.05), not exceed 0.8. Hairs are mainly brown, dark grey- or brown, rarely fulvous *Martes foina*

CONCLUSION

Hair investigation methods require exact identification keys. The qualitative and quantitative characters often show high variance and overlap but statistical analysis may give significant values for identification. Mean values of length, maximal diameter and medullary index show enough consistency to be used for distinguishing Mustelidae. Homogenous brown hairs may belong to almost any of the studied species, excluding the Wild Cat. Its guard hair always has at least one light band, so it could resembles only the Red Fox. Cross-sections are required for separating similar hair of Red Fox and Wild Cat. Two species of mustelids, Badger and Otter can be identified by just a few hairs. Species specific identification is possible in a case of the Stone Marten and Pine Marten, but the investigation demands at least 10–20 or more intact guard hairs. Stoat and Weasel, Polecat and Steppe Polecat compose so called "twin-pairs" where only one significant deviation would help, but it is not enough for exclusive identification. The employment of genetic methods may be necessary for the segregation of these species. The practical application of this method form an integral part of ecological and faunistical research like food-analysis from scats, track-analysis, collecting hairs from baiting-sites, burrows, traps and hair-capture methods.

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RECENT RECORD OF OTOMOPS WROUGHTONI (THOMAS, 1913) (CHIROPTERA: MOLOSSIDAE) FROM MEGHALAYA, NORTH-EAST INDIA

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Otomops wroughtoni (THOMAS, 1913) was named on the basis of about 30 specimens collected from Barapede Caves, 0.5 km from Talewadi village in Karnataka, south-west India (approx. 15°25'N, 74°22'E). This site was subsequently described by PRATER (1914), BROSSET (1962) and BATES *et al.* (1994) but was revisited only intermittently during the 20th century (DANIEL *et al.* 1992). Until recently, *O. wroughtoni* was thought to be restricted to this single location (BATES & HARRISON 1997). However, in December, 2000 an additional specimen was collected in Chhep District, Cambodia (13°59'N, 105°16'E) (WALSTON & BATES 2001). This represented a range extension eastwards of some 3200 km.

Key words: *Otomops wroughtoni*, Molossidae, Chiroptera, India

In March, 2001, during a bat survey in Meghalaya, north-east India a further specimen of *O. wroughtoni* was collected by the senior author. This locality, near Nongtrai village, Shella confederacy (25°11'N, 91°37'E), lies midway between the previous two locality records, approximately 2080 km north-east of the colony in Karnataka and 1920 km north-west of the record from Cambodia.

The single specimen was collected at 19.15 hours on 17 March, 2001. It was caught in a harp trap as it tried to enter the large limestone Phrang Karuh Cave, which is situated at an altitude of 170 metres on the southern fringes of the Shillong plateau in the East Khasi Hill District. The local vegetation is tropical semi-evergreen forest with a high plant diversity including lianas, cane, ferns, herbs, epiphytes and trees such as *Ficus* sp., *Trema* sp., *Hibiscus macrophyllus*, *Gmelina* sp., *Albizzia* sp., *Wallichina* sp., Rubiaceae sp. and wild banana. Cultivated areas in the vicinity include cash crops such as beetlenut, bay leaf, broom, and pepper.

The adult male specimen (Field number: 20.1) is held in the Zoological Survey of India's (ZSI) Shillong zoological collection. It is similar in size and morphology to those from Talewadi and Cambodia described by BATES and HARRISON (1997) and WALSTON and HARRISON (2001) respectively. Its measurements are: forearm 67 mm; tibia 19.5 mm; foot 13.1 mm; tail 43.4 mm; ear 36 mm; greatest length of skull 26.1 mm; condylo-canine length 22.7 mm; zygomatic

breadth 13.8 mm; breadth of braincase 11.2 mm; upper toothrow length (CM^3) 9.2 mm; lower toothrow length (CM_3) 9.8 mm; posterior palatal width taken at the widest point of the crowns of M^3 9.7 mm.

The recent discovery of *O. wroughtoni* in north-east India is of particular zoogeographical interest. At 25°11'N, it is the most northerly record of the genus, nearly 10° north of *O. martiensseni* (MATSCHIE, 1897) in Yemen (15°28'N; AL-JUMAILY 1999) and *O. wroughtoni* (15°25'N) in Karnataka. It also provides further evidence that *Otomops* is far more widespread in southern Asia than previously thought and with a less disjunct distribution.

Currently, *O. wroughtoni* is listed as one of the 15 most critically endangered bat species (HUTSON *et al.* 2001). This was based primarily on the fact that only one roosting colony has ever been located and that it is extremely vulnerable to disturbance and/or destruction. However, if current molecular studies support the view that the specimens from Cambodia, north-east and south-west India are of the same taxon, this status may have to be reviewed. Such studies may also be of considerable interest in determining the relationship between all six, allopatric, widely distributed but poorly known species within the genus (*sensu* WALSTON & BATES 2001) currently described from Africa, Arabia, Asia and Australasia.

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Amphistomes of the World
A check-list of the amphistomes of vertebrates

O. Sey

The amphistomes are one of the rare groups of digenetic trematodes which have a broad spectra of the definitive hosts together with a wide geographical distribution, forming a continuous evolutional lineage from fishes to mammals. At the same time, some species of them are causative agents of devastating disease of domestic and wild animals, mainly ruminants. Therefore, amphistomes may have professional and practical interests for research and thus a great number of information has been accumulated on their classification and biology. The intention of this check-list is to bring together a comprehensive list of the amphistomes, presently known and sources of references of their hosts and geographic distribution (87 pages). This list consists of three main parts. In the first "Parasite/host check-list" (137 pages), parasites were listed under their scientific names, followed by the synonyms, then the name of the authorship as well as the name of the countries from which they were reported. In the second "General host/parasites check-list" (31 pages), host were listed systematically under their scientific names from fishes to mammals, followed by amphistomes described in them in alphabetical order. In the third "Host/parasites check-list by countries" (63 pages), countries were listed alphabetically, hosts systematically and their parasites alphabetically. When it seemed to be necessary some comments were given and they are found in Chapter 7 "Notes" (5 pages). Three indexes (parasite, host and countries) are added to the list (29 pages).

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GEOGRAPHIC VARIATION OF CHEILOSIA VERNALIS (FALLÉN, 1817) (DIPTERA: SYRPHIDAE)

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Natural populations of *Cheilosia vernalis* (FALLÉN, 1817) from village Morinj, Mediterranean area (Montenegro); low mountain Fruska Gora in the Pannonian plain (Serbia) and two high Dinaric mountains Durmitor (Montenegro) and Kopaonik (Serbia) on the Balkan Peninsula were analyzed for genetic variability at 12 enzyme loci. Geographic variation was analyzed based on the presence of specific genotypes, rare and private alleles at *Gpi, Had, Idh-2, Mdh-2, Pgm* and *Sod-1* loci. Difference in genetic structure parameters was also observed.

Key words: *Cheilosia vernalis*, Syrphidae, allozyme, geographic variation

INTRODUCTION

Greatly variable species *Cheilosia vernalis* (FALLÉN, 1817) belongs to the *melanura* group of the genus *Cheilosia*, the family Syrphidae. The lack of mimetic characters, otherwise present in hoverflies, is specific for the tribe Cheilosiini. The species in the genus *Cheilosia* are dark with shiny thorax and abdomen. Comparing with other species groups in this genus, the group *melanura* comprises closely related species with the least differentiated male genitalia diagnostic features (VUJIC 1992) – considered the most important character in the systematics and taxonomy of hoverflies. Population genetic analyses of the species *Cheilosia vernalis* have not been performed, and taxonomy and systematics were based solely on the analysis of morphological traits.

The species *Cheilosia vernalis* has been described 8 times under different names (PECK 1988, VUJIC 1992). This suggests that there had been problems in defining its taxonomic status. Based on interpopulation variability of morphological characters (face in profile – facial tubercula and mouth edge, the shape, size and colour of antennae, distribution and colour of body hairs, cuticular punctuation), it has more than once been suggested that *Ch. vernalis* includes several closely related species (SPEIGHT & LUCAS 1992, VUJIC 1992). However, no satisfactory basis for subdividing the species has yet been demonstrated and the male terminalia of the various different variants appear identical (SPEIGHT & LUCAS 1992).

The species *Ch. vernalis* shows distinct seasonal dimorphism. Spring brood specimens are typically entirely, or predominantly, brown haired and frequently have the third antennal segment orange, while summer specimens tend to be pre-

dominantly dark-haired, with the third antennal segment dark brown (SPEIGHT & LUCAS 1992).

Ch. vernalis is extremely widespread species. It has been registered in most European countries, on Caucasus, in Siberia and the Oriental region. In the northern part of its areal preferred environments are dry meadows with short vegetation, old pasture, dune systems and grassy clearings in woodland, while it becomes increasingly montane in the south (SPEIGHT & LUCAS 1992, TORP 1994). It has been registered in lower altitudes in the north of the Balkan Peninsula and in the Mediterranean zone (MARCOS-GARCIA 1990, VUJIC 1992). *Cheilosia vernalis* can be found in urban biotopes as well: parks, gardens and ruderal environments (BARKEMEYER 1994).

The objective of this study was to analyze the population genetic structure, geographic variation and genetic differentiation among populations of Palaearctic species *Cheilosia vernalis* by allozyme electrophoresis.

MATERIALS AND METHODS

Sample collection

Samples of the species *Cheilosia vernalis* were collected from four geographic regions: Morinj, Montenegro (CVMOR; 46 specimens), Adriatic sea in the Mediterranean area; Fruska Gora Mts, Serbia (CVFG; 26), in hilly area of the Pannonian plain; and two high Dinaric mountains Durmitor, Montenegro (CVDUR; 34) and Kopaonik, Serbia (CVKOP; 6) (Fig. 1).

Investigated areas included different biogeographic landscapes on the Balkan Peninsula. The analyzed populations originating from specific habitats, geographically distant with no gene flow, were a good model for the analysis of genetic diversity and molecular mechanisms of adaptation in *Ch. vernalis*. Collection of the insect material was hindered by the very short period of activity (adults of this species are active only a few days in early spring). In addition, unstable weather conditions often caused the reduction of the population size (CVKOP was very small). However, the inclusion of the population from Kopaonik was important not only for enzyme polymorphism analysis, but also for taxonomic reasons. Morphologically distinct individuals, and unique combination of genotypes at *Gpi* and *Mdh–2* loci were registered (see Results and Discussion), suggesting the presence of cryptic taxa. Good zymogram resolution that enables correct identification of genotypes was an additional challenge. The species had a specific gene expression, and in spite of successful analyses of a large number of isoenzyme loci in other syrphid species and groups (MILANKOV 2001, MILANKOV *et al.* 2001, MILANKOV *et al.* 2002*a, b*), electrophoregrams for the following enzymes could not be obtained: AAT (aspartate amino transferases), AO (aldehyde oxidase) and ME (malic enzyme). Genotype identification for some enzyme systems (GPI, MDH, HAD and SOD) further decreased the number of specimens included in the analysis. Due to the low success in the analysis of *Sod-1*, the allele frequencies at this locus were not included in the analysis of hierarchical structure of the species (Wright's *F* statistics). Further investigation of the biology of *Ch. vernalis* might help explain the difficulties encountered in the analyses, especially for the individuals originating from Kopaonik.



Fig. 1. Map of the Balkan Peninsula. Origin of the analyzed populations of *Cheilosia vernalis*: 1. Fruska Gora, 19°50'E, 45°10'N (Serbia); 2. Kopaonik, 20°40'E, 43°15'N (Serbia); 3. Durmitor, 19°00'E, 43°11'N (Montenegro); 4. Morinj, 18°40'E, 43°29'30''N (Montenegro). Locality Morinj is the territory with intermixed evergreen Mediterranean maritime woodlands and maquis and Submediterranean oak woodlands (*Lauro-Castanetum sativae*; *Rusco-Carpinetum orientalis*; *Orno-Quercetum ilicis*). Mountain Fruska Gora is a low mountain on the south border of the Pannonian plain, mostly covered with South European deciduous woodlands (*Fagus* and different *Quercus*) isolated from other autochthonous forests. Kopaonik and Durmitor are two high Dinaric Mts with different types of biomes, with deciduous woodlands (predominantly *Fagus*) in low altitudes (up to 700 m), European coniferous boreal woodlands (*Picea* and *Pinus*) in the higher altitudes, and the biome of alpine and high Nordic rock-grounds pastures and snow patches in the highest zone on the mountains peaks. The populations of *Ch. vernalis* were collected in *Fagus*, *Picea* and intermixed *Picea* and *Fagus* forests

Temporal variation of the CVMOR population was analyzed based on the genetic differentiation of the 46 specimens collected in years 1995 (CM1: 16), 1997 (CM2: 11) and 1998 (CM3: 19). CVMOR specimens from all three seasons were pooled together for geographic variability analysis of the species. Prior to electrophoresis, species were identified based on the shape of face, colour of legs and the length and colour of hairs on mesonotum and scutellum.

Allozyme analysis

The genetic variation was studied by standard 5% polyacrylamide gel electrophoresis (MUNSTERMANN 1979) with slight modifications (MILANKOV 2001). Tris-Boric-EDTA (pH 8.9) buffer was used to assay fumarate hydratase (E.C. 4.2.1.2. FUM; *Fum*), glucose phosphate isomerase (E.C. 5.3.1.9. GPI; *Gpi*), hexokinase (E.C. 2.7.1.1. HK; *Hk-2, Hk-3*), phosphoglucomutase (E.C. 2.7.5.1. PGM; *Pgm*), and superoxide dismutase (E.C. 1.15.1.1. SOD; *Sod-1*). Tris-Citric (pH 7.1) buffer was used to assay α-glycerophosphate dehydrogenase (E.C. 1.1.1.8. GPD; *Gpd-2*), 2-hydroxy acid dehydrogenase (E.C. 1.1.99.6. HAD; *Had*); isocitrate dehydrogenase (E.C. 1.1.1.42. IDH; *Idh-1, Idh-2*), and malate dehydrogenase (E.C. 1.1.1.37. MDH; *Mdh-1, Mdh-2*).

Insect specimen electrophoresis was performed in the same gel for direct interpopulation comparison. Loci were numbered and alleles marked alphabetically with respect to increasing anodal migration. Extracts from different body regions were used for the analysis of isozyme variability depending on metabolic function and regional distribution of enzyme (head + 0.10 ml: FUM, HK, IDH, MDH, PGM; thorax + 0.15 ml: GPD, GPI, HK, IDH, SOD). Duration of electrophoretic run at 90 mA (141–210V) was 2.00–4.00 hrs.

Analysis

Geographic variation of the species *Ch. vernalis* was investigated by analysis of specific homozygous genotypes and private (unique) alleles. Statistical analysis of electrophoretic variability data was performed using BIOSYS-1 (SWOFFORD & SELANDER 1981). The tests included: genotype and allele frequency, the percentage of polymorphic loci (P), mean observed and expected heterozygosity (H_o, H_e) for small samples corrected using Levene's (1949) formula. Difference between H_o and H_e at separate variable loci was evaluated using Wright's inbreeding coefficient (F; WRIGHT 1951) with the mean F statistics calculated by a Jack-knifing procedure over loci (WEIR 1990) and SELANDER's (1970) D statistics. Wright's F statistics, the deviation of H_o from H_e, three levels of genetic differentiation F_{is} (variation within subpopulation), F_{it} (homozygosity of individual relative to the total population), and F_{st} (amount of subdivision relative to the limiting amount under complete fixation) were calculated. Genetic identity (NEI 1972) was used to perform hierarchical cluster analysis using arithmetic averages (UPGMA) and the relationships were summarized in the form of dendrogram.

RESULTS

Nine enzyme systems coded by alleles of 12 loci were assayed in populations of the *Cheilosia vernalis*. *Fum*, *Gpd*-2 and *Idh*-1 loci were monomorphic in all populations. *Hk-2* and *Hk-3* loci were polymorphic only in CVMOR, *Idh*-2 in

CVDUR and CVFG, *Mdh*-1 in CVDUR and CVKOP, *Mdh*-2 in CVKOP and CVFG, while *Pgm* was monomorphic only in CVMOR. The greatest number of alleles (22) was registered in CVDUR and CVFG populations, followed by CVKOP (19) and CVMOR (17) (Table 1).

Heterozygotes $Gpi^{b/h}$ (except CVMOR), $Had^{k/o}$ (CVMOR, CVDUR), $Had^{o/s}$ (except in CVMOR), $Idh\text{-}2^{e/g}$ (CVDUR, CVFG), $Pgm^{a/e}$, $Pgm^{b/c}$ (CVDUR) and $Sod\text{-}1^{a/c}$ (CVFG) showed geographic distribution. Six out of seven registered het-

Table 1. Genotype frequencies at variable loci in the populations of *Cheilosia vernalis*

Locus	Genotype	CVMOR	CVDUR	CVKOP	CVFG
Gpi	*b/b*	–	–	0.400	–
	f/f	0.043	–	–	0.038
	g/g	0.239	0.333	0.200	0.231
	h/h	0.718	0.576	0.200	0.693
	b/h	–	0.091	0.200	0.038
Had	*o/o*	0.769	0.818	0.750	0.200
	p/p	–	0.045	–	0.500
	k/o	0.231	0.045	–	–
	o/s	–	0.092	0.250	0.300
Hk-2	*e/e*	0.214	–	–	–
	f/f	0.786	1.000	1.000	1.000
Hk-3	*e/e*	0.214	–	–	–
	f/f	0.786	1.000	1.000	1.000
Idh-2	*e/e*	1.000	0.889	1.000	0.960
	e/g	–	0.111	–	0.040
Mdh-1	*a/a*	1.000	0.794	0.800	1.000
	b/b	–	0.206	0.200	–
Mdh-2	*a/a*	–	–	–	0.167
	b/b	1.000	1.000	0.667	0.833
	c/c	–	–	0.333	–
Pgm	*a/a*	–	–	0.200	–
	b/b	–	0.119	–	0.040
	c/c	1.000	0.735	0.400	0.440
	e/e	–	0.088	0.400	0.520
	a/e	–	0.029	–	–
	b/c	–	0.029	–	–
Sod-1	*a/a*	1.000	1.000	1.000	0.889
	a/c	–	–	–	0.111

erozygotes at five loci were found in CVDUR, two of which were unique. Four heterozygotes were registered in CVFG (1 unique), two in CVKOP and one in CVMOR. High-mobility alleles at *Sod-1*, *Had* and *Idh-2* loci were not registered as homozygotes (Table 1).

Three unique homozygotes were registered in CVKOP (*Gpi*$^{b/b}$, *Mdh-2*$^{c/c}$, *Pgm*$^{a/a}$), 2 in CVMOR (*Hk-2*$^{e/e}$, *Hk-3*$^{c/c}$) and 1 in CVFG (*Mdh-2*$^{a/a}$) (Table 1). Two private alleles were detected in CVMOR (*Hk-2*^{e}, *Hk-3*^{e}) and CVFG (*Mdh-2*^{a}, *Sod-1*^{c}), one in CVKOP (*Mdh-2*^{c}), while none were registered in CVDUR (Tables 1 & 2).

The presence of major (≥0.5) and rare (<0.05) alleles indicated genetic divergence among populations of *Ch. vernalis*. The same major alleles at *Hk-2, Hk-3, Idh-2, Mdh-1, Mdh-2* and *Sod-1* were registered in all investigated populations. However, different major alleles were found at *Gpi* (in CVKOP) and *Had* (CVFG). The majority of rare alleles was registered in CVDUR (5), CVFG (4) and CVMOR (1). The largest number (3) of rare alleles was registered at *Had* in CVDUR (Table 2).

Difference between observed (H_o) and expected (H_e) heterozygosity based on Hardy-Weinberg values was statistically significant for all variable loci in all populations except *Had* (CVMOR and CVKOP), *Idh-2* (CVDUR, CVFG) and *Sod-1* (CVFG) (Table 3). Genotype fixation index, *F*, indicated excess homozygosity ($F_{is} > 0$) in all populations at all loci, except at *Had* in CVMOR and CVKOP populations, at *Idh-2* in CVDUR and CVFG, and *Sod-1* in CVFG (Table 3). These results were in

Table 2. Allelic frequencies at heterozygous loci in the populations of *Cheilosia vernalis*

Locus	Allele	CVMOR	CVDUR	CVKOP	CVFG
Gpi	*b*	–	0.045	0.500	0.019
	f	0.043	–	–	0.038
	g	0.239	0.333	0.200	0.231
	h	0.718	0.621	0.300	0.712
Had	*k*	0.115	0.023	–	–
	o	0.885	0.886	0.875	0.350
	p	–	0.045	–	0.500
	s	–	0.045	0.125	0.150
Idh-2	*e*	1.000	0.944	1.000	0.980
	g	–	0.056	–	0.020
Pgm	*a*	–	0.015	0.200	–
	b	–	0.132	–	0.040
	c	1.000	0.750	0.400	0.440
	e	–	0.103	0.400	0.520
Sod-1	*a*	1.000	1.000	1.000	0.944
	c	–	–	–	0.056

accordance with Selander's *D* statistics, since *D* was 0 only for *Had* in CVKOP and *Idh-2* in CVFG (Table 3).

F statistics was used to describe temporal variation among CVMOR samples collected in three seasons: 1995 (CM1), 1997 (CM2) and 1998 (CM3). Standardized variance of allele frequency, F_{st} value, indicated high genetic substructuring (F_{st}=0.377). The comparison of pairs of subpopulations showed that 33% of the allele frequency variance at *Gpi, Had, Hk-2* and *Hk-3* was due to genetic differentiation between CM1 and CM2 subpopulations. *F* statistics for CM2 and CM3 showed the lack of substructuring (F_{st}=0.063). Estimates of genetic variability showed that CM1 subpopulation ranked the highest in percentage of polymorphic loci (33.3%) and in the mean number of alleles per locus (1.4), followed by CM3 (25%; 1.3) and CM2 with the lowest values (16.7%; 1.2). Contrary to the above

Table 3. Deviation from Hardy-Weinberg equilibrium of genotype frequencies at nine polymorphic loci in the populations of *Cheilosia vernalis*

Locus	Population	H_o	H_e	F_{is}	D	P
Gpi	CVMOR	0	19.824	1.000	–1.000	***
	CVDUR	3	16.785	0.819	–0.821	***
	CVKOP	1	3.444	0.677	–0.710	*
	CVFG	1	11.627	0.912	–0.914	***
Had	CVMOR	6	5.412	–0.130	0.109	ns
	CVDUR	3	4.721	0.350	–0.365	*
	CVKOP	1	1.000	–0.143	0.000	ns
	CVFG	3	6.368	0.504	–0.529	*
Hk-2,3	CVMOR	0	9.600	1.000	–1.000	***
Idh-2	CVDUR	2	1.943	–0.059	0.029	ns
	CVFG	1	1.000	–0.020	0.000	ns
Mdh-1	CVDUR	0	11.284	1.000	–1.000	***
	CVKOP	0	1.778	1.000	–1.000	*
Mdh-2	CVKOP	0	2.909	1.000	–1.000	**
	CVFG	0	6.809	1.000	–1.000	***
Pgm	CVDUR	2	14.119	0.856	–0.858	***
	CVKOP	0	3.556	1.000	–1.000	***
	CVFG	0	13.633	1.000	–1.000	***
Sod-1	CVFG	2	1.943	–0.059	0.029	ns

H_o = Observed heterozygosity; H_e = Expected heterozygosity over all loci; F_{is} = Fixation index (WRIGHT, 1951); D = Selander's coefficient; P = Level of significance (ns = not significant, * = significant at $P \leq 0.05$, ** = significant at $P \leq 0.01$, *** = significant at $P \leq 0.001$)

Table 4. Summary of Wright's F statistics at eight polymorphic loci in the populations of *Cheilosia vernalis*

Locus	F_{is}	F_{st}	F_{it}
Gpi	0.905	0.027	0.907
Had	0.260	0.262	0.454
Hk-2	1.000	0.163	1.000
Hk-3	1.000	0.163	1.000
Idh-2	–0.021	0.012	–0.009
Mdh-1	1.000	0.166	1.000
Mdh-2	1.000	0.222	1.000
Pgm	0.937	0.319	0.957
Mean	0.799	0.185	0.836
	Jack-knife estimates over loci		
Mean	0.801	0.183	0.834
S.D. (x)	0.133	0.069	0.106

mentioned parameters, the highest value of mean heterozygosity was observed in CM2 (0.036) followed by CM1 (0.017) and CM3 (no heterozygotes).

The mean fixation index at total population was high (F_{it}=0.798), but the loci did not contribute equally. F_{it} values at *Gpi, Hk-2, Hk-3, Mdh-1, Mdh-2* and *Pgm* loci were high (from 0.907 to 1.000), except *Had* (F_{it}=0.454). Negative F_{it} values were registered at *Idh-2* locus. Fixation index (F_{is}) showed persistent heterozygosity excess only at *Idh-2* ($F_{is} < 0$). Except at *Had*, local inbreeding was more important ($F_{is} > F_{st}$). F_{st} as a measure of genetic differentiation between populations indicated genetic subdivision (F_{st}=0.185). Value of *F* parameters by Jack-knife estimates over loci (0.183) were in accordance with previous results (Table 4).

Analysis of population genetic structure parameters showed small differences in the mean number of alleles per locus (*A*) and average H_o. Average H_o in all populations was smaller than H_e. The mean number of alleles per locus, and the frequency of polymorphic loci were the smallest in CVMOR, and higher in the other three populations. Based on the 0.99 criterion, the highest percent of polymorphic loci was registered in CVFG (Table 5).

Genetic identity by locus among conspecific populations was almost complete ($I > 0.95$) at 81% of the analyzed loci, while no loci showed complete genetic difference ($I < 0.05$). Based on the average genetic identity (*I:* Nei, 1972), CVMOR and CVDUR were more similar to each other then to the other populations. Genetic identity among these populations and CVKOP (next cluster) ranged from 0.928 (between CVMOR and CVKOP) to 0.960 (between CVKOP and CVDUR). The

Table 5. Estimates of genetic structure parameters in the populations of *Cheilosia vernalis*

Population	n (SE)	A	H_e (SE)	H_o (SE)	Private allele	$P_{(0.95)}$
CVMOR	36.3 (3.8)	1.42 (0.19)	0.110 (0.049)	0.019 (0.019)	1	0.333
CVDUR	27.3 (2.9)	1.83 (0.34)	0.132 (0.054)	0.033 (0.015)	0	0.417
CVKOP	4.5 (0.5)	1.58 (0.23)	0.208 (0.082)	0.037 (0.025)	1	0.417
CVFG	21.3 (1.8)	1.83 (0.30)	0.172 (0.070)	0.041 (0.025)	2	0.417 (0.500)
Mean	22.35	1.675	0.156	0.033	–	0.375 (0.396)

n = Mean sample size per locus, SE = standard error; A = Mean number of alleles per locus; H_e = Expected heterozygosity averaged over all loci; H_o = Average frequency of observed heterozygosity; $P_{(0.95)}$ = Frequency of polymorphic loci based on the 0.95 (0.99) criterion

third cluster was formed by CVFG. Genetic identity among CVFG and the other 3 populations ranged from 0.933 (CVFG and CVMOR; CVFG and CVKOP) to 0.954 (CVFG and CVDUR) (Fig. 2).

DISCUSSION

The use of morphological characters in defining cryptic taxa and evolutionary relationships of closely related species has been proven insufficient in many groups of organisms (SHARMA *et al.* 1999), especially in insects (FOLEY *et al.* 1995, NARANG *et al.* 1993, MILANKOV *et al.* 2000, 2001). The reasons for this are contribution of ecological variance to the overall phenotype variance, complicated defining of polygene genetic control of morphological characters and pleiotropic effect. Also, the difference in selection pressures on different traits and speed of

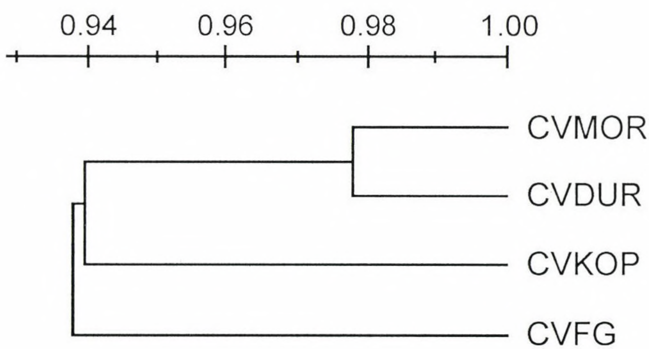


Fig. 2. Dendrogram of genetic relationships among the populations of *Cheilosia vernalis* species using unweighted pair group clustering of NEI's (1972) identity

evolutionary changes in genes at certain loci might cause the absence of correlation between morphological and gene-enzyme variability.

There had been problems in defining the taxonomic status of widely distributed Palaearctic species *Ch. vernalis* based on the analysis of morphological characters. Due to high variability of the studied parameters and distinct seasonal dimorphism it has more than once been suggested that *Ch. vernalis* comprises several closely related species (SPEIGHT & LUCAS 1992, VUJIC 1992). The results of gene-enzyme analysis and descriptions of morphological characters were compared for each specimen. No correlation was found between morphological characters and particular genotypes or alleles. The specimens with distinct morphological traits did not have unusual genotypes, while specimens with unique genotypes had no particular morphological differences comparing to specimens with the most frequent genotypes. No correlation between sex and certain alleles or genotypes was registered. However, specific combination of rare alleles in *Gpi* and *Mdh-2* loci was found. Only in two specimens from CVKOP homozygote $Gpi^{b/b}$ was registered, and in the both instances combined with a unique homozygote $Mdh\text{-}2^{c/c}$. This unique combination of specific homozygotes suggests possible presence of cryptic taxa, but further investigation is necessary. It is important to point out that the allele Gpi^{b} (<0.05) was present only in heterozygous combinations in CVDUR and CVFG.

The reason for the significant deviation (Table 3) between observed and expected genotype frequencies at *Gpi* locus is probably the observed specific pattern of GPI zymogram. The populations of *Ch. vernalis* had the heterozygous combination characteristic for other syrphid populations (MILANKOV 2001), with "slow" and "fast" allelomorph. Unique for two individuals from CVKOP was the genotype $Gpi^{b/b}$. No other syrphid population had the homozygote formed by the "slow" allelomorphs (MILANKOV 2001). Possible explanation for the deviation of genotype frequencies from the expected values for *Gpi* locus might be the presence of the lethal recessive allele, as well as inability to detect the activity of the allozyme coded by alleles in the homozygous combination. Also, individuals might have differential survival due to selection pressure against the "slow" homozygotes. Significant deviation of the observed genotype frequencies from the expected at *Mdh-2* in CVKOP population might be due to the cryptic taxon with specific combination of genotypes $Gpi^{a/a}$ and $Mdh\text{-}2^{c/c}$. Random changes (drift) in genotype frequencies can be very important in small populations, thus it has to be included in population – genetic analysis. It is also important to bear in mind that the period of activity is very short (only a few days) for adults of *Ch. vernalis* and is strongly impacted by environment (unstable weather conditions in early spring cause the reduction of the effective population size). Registered differences in values of ge-

netic structure parameters were probably due to association between genetic variability, level of ecological heterogeneity and effective size of populations. The small population of changeable size, originating from Morinj, had the smallest mean number of alleles per locus and average frequency of observed heterozygosity. The highest values of these parameters were registered in the population from Fruska Gora. Very small numbers of active adults were registered in 1995, 1996 and 1997 in CVFG population. This might have been due to the high mortality caused by sudden changes in temperature, which might have affected the genetic structure of the population. The way in which the weather conditions can significantly influence the effective population size is illustrated by the registered differences among the three samples of CVMOR collected in different years. Comparison of genetic variability parameters and F_{st} estimates among samples collected in different years showed that the small population CVMOR had unstable genetic structure. The highest value of the standardized variance (F_{st}) between CM1 and CM2, the lowest polymorphism, and the average number of alleles per locus calculated for CM2 are indicators of possible population bottleneck (severe reduction of population size), or selection "against" certain alleles (that is, phenotypes). Thus, the allele Hk^{e}, and the rare allele Gpi^{f} [allozymes of this locus show thermal stability differences (WATT *et al.* 1996, KAIN *et al.* 1997) as well as latitudinal clines (MILANKOV *et al.* 2001)] were registered in CM1 and CM3, but not in CM2. Differential selection might have caused the presence of the registered heterozygote $Had^{k/o}$ in CM1 and CM2, but not in CM3 sample.

The analysis of allozyme variability and interpopulation genetic divergence among Mediterranean population from Morinj, two montane populations from Durmitor and Kopaonik and population from the low Pannonian mountain Fruska Gora, presented in this paper, showed that this extraordinary variability could presently be interpreted as geographic variability. The presence of major alleles indicated genetic divergence of the analyzed populations of *Ch. vernalis*. Spatial distribution of genotypes, rare and major alleles caused distinct structuring of the species. F_{st} as index of genetic differentiation was 0.185 among analyzed populations. Population subdivision of *Ch. vernalis* was due to differences of allele frequency variances at *Pgm*, *Had* and *Mdh-2*. Genetic divergence among populations was, to a lesser extent, affected by allelic frequency variance at *Mdh-1*, *Hk-2* and *Hk-3*. Besides the decreased gene flow between geographically distant populations, elimination or favorization of alleles and genotypes through natural selection, and coadaptation of gene combinations to specific habitat conditions, historic factors played a role in genetic divergence. Rare alleles suggest the possibility of population bottlenecks in the past (MUNSTERMANN 1994).

Genetic differentiation of investigated populations falls within local population differentiation values of fruitflies *Drosophila willistoni* sibling species (AYALA *et al.* 1974) and hoverflies *Merodon avidus* A and *M. avidus* B of the *avidus* group (MILANKOV *et al.* 2001). The small number of analyzed specimens, and the possible presence of cryptic taxa, caused CVKOP to have the lowest calculated genetic identity values. Genetic divergence of CVKOP and CVFG was due to specific genotype $Gpi^{b/b}$ and the difference of $Gpi^{h/h}$ and $Gpi^{b/h}$ genotype frequencies. Spatial variability of the genotypes at *Had* and *Pgm* loci caused genetic differentiation of CVFG from other analyzed populations of *Ch. vernalis*.

*

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Checklist of the Diptera of Hungary

Edited by L. Papp

This is an international undertaking of 20 authors: a checklist of the dipterous species found through the end of 2000 in Hungary, with references to their first reliable records in the territory of modern Hungary. The "minimum requirements" for a "first record" are to have the name of the identifier and the place of deposition, and to have evidence that the site is a locality of present-day Hungary. The starting point for most parts is Thalhammer's Fauna Regni Hungariae in 1900 and every family part has a short introduction. These parts contain data on the number of recorded species and on the number of species expected to occur in Hungary. Most of the voucher specimens are deposited in the Diptera collection of the Department of Zoology, Hungarian Natural History Museum, Budapest (HNHM); in exceptional cases the name of the relevant institution is given. There are numerous species new to Hungary reported here for the first time, however, the dipterous fauna of Hungary is still poorly known with 5550 species in this book. According to our present knowledge no less than 10000 species may occur in the country.

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SYSTEMATIC REDEFINITION OF TAXA BELONGING TO THE GENERA AHERMODONTUS BÁGUENA, 1930 AND AMMOECIUS MULSANT, 1842, WITH DESCRIPTION OF THE NEW GENUS VLADIMIRELLUS (COLEOPTERA: APHODIIDAE)

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Species belonging to the genera *Ahermodontus* BÁGUENA, 1930 and *Ammoecius* MULSANT, 1842 are redescribed and illustrated. *Vladimirellus* gen. n. is erected for *Aphodius (Ammoecius) socors* BALTHASAR, 1967. Systematic and/or nomenclatorial status are discussed resulting in new combinations and/or new status as follows: *Pseudoxyomus armaticeps* (PÉRINGUEY, 1901), *Australaphodius catulus* (BALTHASAR, 1946), *Pseudagoliinus oreotragi* (ENDRŐDI, 1978), *Pseudagoliinus tonderae* (ENDRŐDI, 1980). The following new synonymies are established: *Ammoecius bidentulus* HAROLD, 1871, syn. n. = *A. lugubris* BOHEMAN, 1857; *Aphodius (Ammoecius) dentinus* PÉRINGUEY, 1901, syn. n. = *A. lugubris* BOHEMAN, 1857; *Aphodius (Ammoecius) dukei* ENDRŐDI, 1964, syn. n. = *A. mimus* (PÉRINGUEY, 1901); *Aphodius (Ammoecius) kochi* PETROVITZ, 1961, syn. n. = *A. mimus* (PÉRINGUEY, 1901); *Aphodius (Ammoecius) orycis* ENDRŐDI, 1980, syn. n. = *A. terminatus* HAROLD, 1869; *Aphodius (Ammoecius) orycoides* ENDRŐDI, 1980, syn. n. = *A. terminatus* HAROLD, 1869; *Aphodius (Ammoecius) persimilis* SCHATZMAYR, 1946, syn. n. = *A. elevatus* (OLIVIER, 1789); *Aphodius (Ammoecius) tschinghaicus* BALTHASAR, 1971, syn. n. = *Loraphodius kashmirensis* (Sharp, 1878). Neotypes are designated for *Ammoecius elevatus* OLIVIER, 1789 and *A. numidicus* MULSANT, 1851. Lectotypes are designated for *Ammoecius bidentulus* HAROLD, 1871, *A. lugubris* BOHEMAN, 1857, *A. terminatus* HAROLD, 1869 and *A. persimilis* SCHATZMAYR, 1946. With 108 figures.

Key words: Aphodiini, *Ahermodontus*, *Ammoecius*, *Vladimirellus*, new genus, systematics, nomenclature, distribution

INTRODUCTION

In his catalogue, DELLACASA M. (1988) listed 38 and 3 species for *Ammoecius* MULSANT, 1842 and *Ahermodontus* BÁGUENA, 1930, respectively. Since then a number of relevant nomenclatorial and taxonomical changes have been made. We deemed it necessary to thoroughly revise the systematics of the taxa involved, to update taxonomical positions, and to redescribe and illustrate the taxa.

The types of critical taxa were examined. Otherwise, it seemed unnecessary to study types of well-known, easily identifiable species.

The materials examined are preserved in the following institutions or private collections: BCVLB = BORDAT P. collection, Verrière le Buisson, Paris (France); DCG = DELLACASA G. & M. collection, Genova (Italy); HNHMB = Hungarian Natural History Museum, Budapest (Hungary); MCSNM = Museo Civico di Storia Naturale, Milan (Italy); MHNG = Muséum d'Histoire Naturelle, Geneva (Switzerland); MNHNP = Muséum national d'Histoire naturelle, Paris (France); NRS = Naturhistoriska Riksmuseet, Stockholm (Sweden); PCM = PITTINO R. collection, Milan (Italy); SAMCT = South African Museum, Cape Town (South Africa); TMP = Transvaal Museum, Pretoria (South Africa).

SPECIES REMOVED FROM GENUS AMMOECIUS

The following species no longer belong to the genus *Ammoecius*:

Aphodius (Ammoecius) cribripennis PETROVITZ, 1964 from Sneeuw-Berge (South Africa), is a junior synonym of *Harmogaster exarata* HAROLD, 1861 as established by DELLACASA M. (1988: 117). The holotype of *H. exarata* (MHNG) was examined by P. BORDAT, who determined the taxon surely belongs to the genus *Harmogaster*. However, because the specimen is a female, some doubts remain on the specific attribution.

Aphodius (Ammoecius) kovacsi BORDAT, 1990 moved to the genus *Ammoecioides* BORDAT, 1999 (BORDAT 1999: 170).

Aphodius (Ammoecius) mulanje BORDAT, 1985 moved to the genus *Ammoecioides* BORDAT, 1999 (BORDAT 1999: 172).

Aphodius (Ammoecius) pannonicus PETROVITZ, 1961 from Hungary, is a junior synonym of *Loraspis frater* MULSANT et REY, 1870, as already stated by ÁDÁM (1994: 13). The status was confirmed by the study of the type.

Aphodius (Ammoecius) sparsepunctatus PETROVITZ, 1964 moved to the genus *Ammoecioides* BORDAT, 1999 (BORDAT 1999: 176).

Aphodius (Ammoecius) spectabilis PÉRINGUEY, 1901 (nunc *Ammoecioides spectabilis spectabilis*) moved to the genus *Ammoecioides* BORDAT, 1999 (BORDAT 1999: 177).

Aphodius (Ammoecius) tricarinulatus SCHMIDT, 1907 (*nomen novum* for *Aphodius carinulatus* PÉRINGUEY, 1901, nec *Aphodius carinulatus* Motschulsky, 1863, nunc *Ammoecioides spectabilis tricarinulatus*) moved to the genus *Ammoecioides* BORDAT, 1999 (BORDAT 1999: 179).

The following Nearctic species certainly do not belong to the genus *Ammoecius*. They should be placed in different and probably new genera. However, the redefinition of their systematic position is out of the aims of this work:

Aphodius acerbus HORN, 1887 from Texas (probably near San Antonio).
Aphodius aculeatus ROBINSON, 1940 from Utah (Richfield, Sevier County).
Aphodius asellus SCHMIDT, 1907 (*nomen novum* for *Aphodius nanus* HORN, 1887, nec *Aphodius nanus* FAIRMAIRE, 1860) from Texas (Carrizo Spring).

Based on the study of type material, the following species are herewith removed from the genus *Ammoecius*:
Aphodius (Ammoecius) tshingchaicus BALTHASAR, 1971 from Tschingchai, Kuku-Nor, 3200 m, China. The study of the female holotype (NMP) shows it to be a junior synonym of *Loraphodius kashmirensis* (Sharp, 1878).
Aphodius (Ammoecius) socors BALTHASAR, 1967 from Thomsk (Siberia). Based on the study of the male holotype we ascertained that it belongs to a new genus. Description of *Vladimirellus* gen. n. as well as redescription of *Aphodius socors* with its new systematic position are given in this paper.

Based on the study of type material and according to the generic limits defined by DELLACASA G. *et al.* (2001), P. BORDAT is able to establish the following systematic positions of four Afrotropical taxa previously considered belonging to *Ammoecius*:

Pseudoxyomus armaticeps (PÉRINGUEY, 1901), **comb. n.**

Aphodius (Ammoecius) armaticeps PÉRINGUEY, 1901: 410.

Type locality: "Dunb." [Dunbrody, near Uitenhage, Eastern Cape Province, South Africa.]
Type depository: South African Museum, Cape Town.

Remarks – Authors dealing with this taxon (SCHMIDT 1922: 71, PETROVITZ 1964: 188, ENDRŐDI 1978: 179, ENDRŐDI & RAKOVIČ 1981: 42) have always considered it to belong in *Ammoecius* MULSANT. The type specimen (designated "neotype" by ENDRŐDI, *in litteris*) bears the locality label mentioned above. Thus, it was not from the type locality recorded by PÉRINGUEY in the original description (i. e. "Prince Albert, Cape Province"). A study of this "neotype", at present the sole available specimen, allows us to place *A. armaticeps* into the genus *Pseudoxyomus*.

Australaphodius catulus (BALTHASAR, 1946), **stat. n.** et **comb. n.**

Aphodius (Ammoecius) catulus BALTHASAR, 1946: 54; ENDRŐDI & RAKOVIČ 1981: 42 (as a doubtful synonym of *A. brevitarsis* PÉRINGUEY, 1901).

Type locality: "Africa austr., Caffraria". [South Africa.]
Type depository: National Museum, Prague. Type probably lost.

Remarks – The type specimen was not found in BALTHASAR's collection at the Prague Museum. In the key to Afrotropical *Ammoecius* PETROVITZ (1964: 189) placed this taxon among those with the clypeus rounded at sides of median sinuosity and with the epistoma finely punctured, neither rugose nor granulose in front of anterior carina. These are the same distinguishing characters used by BALTHASAR in the original diagnosis. ENDRŐDI (1978) did not deal with this taxon, while ENDRŐDI and RAKOVIČ (1981: 42) proposed a doubtful synonymy of *A. catulus* as *A. brevitarsis* PÉRINGUEY, 1901 (now a junior synonym of *Australaphodius frenchi* BLACKBURN, 1858). BORDAT (1990: 315) accepted this interpretation and, based on characters stressed by the original description, moved *A. catulus* from *Ammoecius* to *Australaphodius*. Without the examination of the type, it is not certain whether *A. catulus* is identical with *A. frenchi* or *Australaphodius accola* (KOLBE, 1908). Thus it is considered, until proved otherwise, to be a valid species.

Pseudagoliinus oreotragi (ENDRŐDI, 1978), **comb. n.**

Aphodius (Ammoecius) oreotragi ENDRŐDI, 1978: 181.

Type locality: Shneeukop, SW Cap. [South Africa.]
Type depository: Transvaal Museum, Pretoria.

Remarks – This taxon shows most of the distinguishing characters of the genus *Pseudagoliinus* BORDAT, 1994. Being monotypic at the time of its description, the diagnosis of *Pseudagoliinus* was obviously created on the basis of its type species, *Pseudagoliinus sinuatipes* (BORDAT, 1994). However, some generic characters (e.g. elytral interstices apically subcariniform and sharply bordered at each side) do not fit with those of *P. oreotragi,* thus these characters have to be downgraded to species level. The shape of the parameres is particularly significant, because in *P. oreotragi* they have an elongate apical seta, while they are glabrous in *P. sinuatipes* and in *P. tonderae* (ENDRŐDI, 1980). It must be noted that this difference is also found in the sibling species of other genus-group taxa. For example, it is found in *Pseudopharaphodius anthrax* (GERSTAECKER, 1871) and *Pseudophara-*

phodius kaszabi (ENDRŐDI, 1957) and in *Lorditomaeus bifidus* SCHMIDT, 1908 and *Lorditomaeus similis* BORDAT, 1996.

Pseudagoliinus tonderae (ENDRŐDI, 1980), **comb. n.**

Aphodius (Ammoecius) tonderae ENDRŐDI, 1980: 35.

Type locality: Heidelberg, South Africa.
Type depository: Hungarian Natural History Museum, Budapest.

Remarks – The study of a paratype, preserved in the Pretoria Museum, allows us to move this species from *Ammoecius* to *Pseudagoliinus*. *Pseudagoliinus tonderae* is very similar to *P. oreotragi* from which it is easily distinguishable by the shape of the parameres.

SYSTEMATIC PART

Vladimirellus gen. n.

Type species: *Aphodius socors* BALTHASAR, 1967

Diagnosis: *Species parvae, subovatae, fortiter convexae, glabrae. Nigrae. Capite cupuliformi; epistoma antice transversim modice carinato; clypeo medio leviter sinuato, lateribus denticulato; pronoto basi marginato; scutello parvo, triangulari, lateribus distincte sulcato; elytris humeribus denticulatis; striis latis, fortiter impressis, distincte crenulatis, punctis medio granulo-catenulatis; interstitiis modice convexis, utrinque striolatis. Metatibiis setis apicalibus longitudine aequalibus.*

Description: Length 4.0 mm. Short, oval, strongly convex, glabrous. Blackish. Head cupuliform, epistoma anteriorly with feeble transverse carina, clypeus faintly sinuate at middle, denticulate at sides, thinly bordered laterally, border glabrous; genae widely rounded, faintly protruding more than eyes; frontal suture feebly raised, weakly tuberculate at middle. Pronotum transverse, doubly coarsely punctured, base bordered. Scutellum small, regularly triangular with curved sides and laterally with two distinct oblique impressions. Elytra sharply denticulate at shoulder; striae wide, rather shiny, strongly impressed, distinctly crenulate, punctures granulate at middle and joined each other by a fine carina; interstices feebly convex, strongly microreticulate, sparsely finely and irregularly punctured, at each side with a superficial striola along the stria (Fig. 6). Fore tibiae distally tridentate and proximally faintly serrulate at outer margin; upperside smooth. Middle and hind tibiae with strong transverse carinae on outer face; apically fimbriate with very short and equal spinules. Pygidium glabrous, strongly microreticulate thus dull, superficially confusedly punctured, with trace

of longitudinal groove toward apex. Sexual dimorphism probably shown in males (females unknown) mainly by fore tibiae apical spur stout, cylindrical, abruptly downward curved toward apex. Aedeagus strongly sclerotized with very short paramera apically rounded (Figs 7–8). Epipharynx with anterior margin feebly bisinuate and widely rounded at sides; epitorma drop-shaped; corypha with rather short and stout apical spiculae protruding beyond front margin; pedia pubescent toward corypha only and with several strong chaetae serially arranged obliquely; chaetopariae dense and moderately elongate (Fig. 5).

Distribution: Northeastern Palearctic region (Siberia).

Etymology: Named in honour of Dr. VLADIMIR BALTHASAR, describer of the type species.

Remarks – The genus is readily distinguishable from *Ammoecius* because of the peculiar shape of the elytral striae.

Vladimirellus socors (BALTHASAR, 1967), **comb. n.** (Figs 1, 5–8)

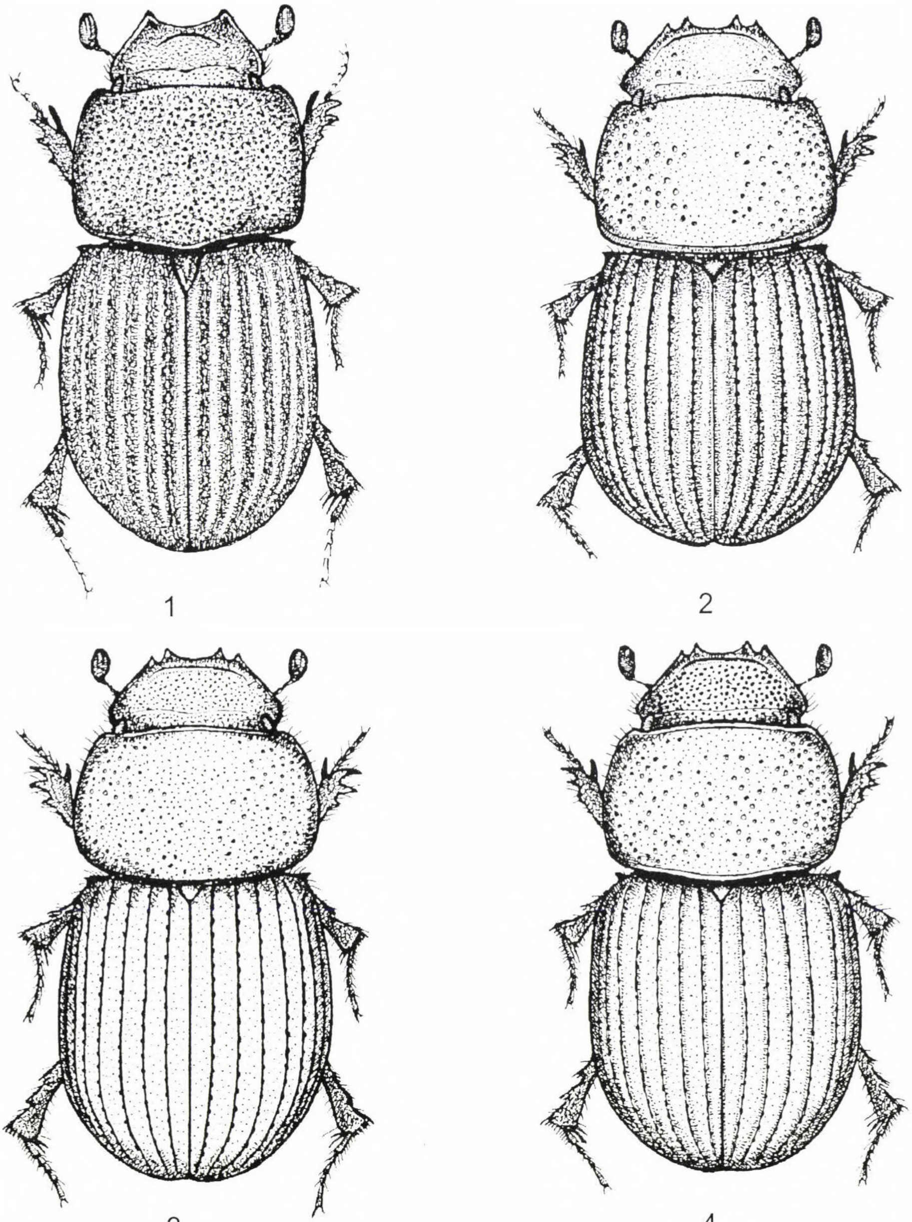
Aphodius (Ammoecius?) socors BALTHASAR, 1967: 127.
Aphodius (Ammoecius) socors: DELLACASA M. 1988: 200.

Type locality: "Thomsk, Sibirien". [Siberia.]

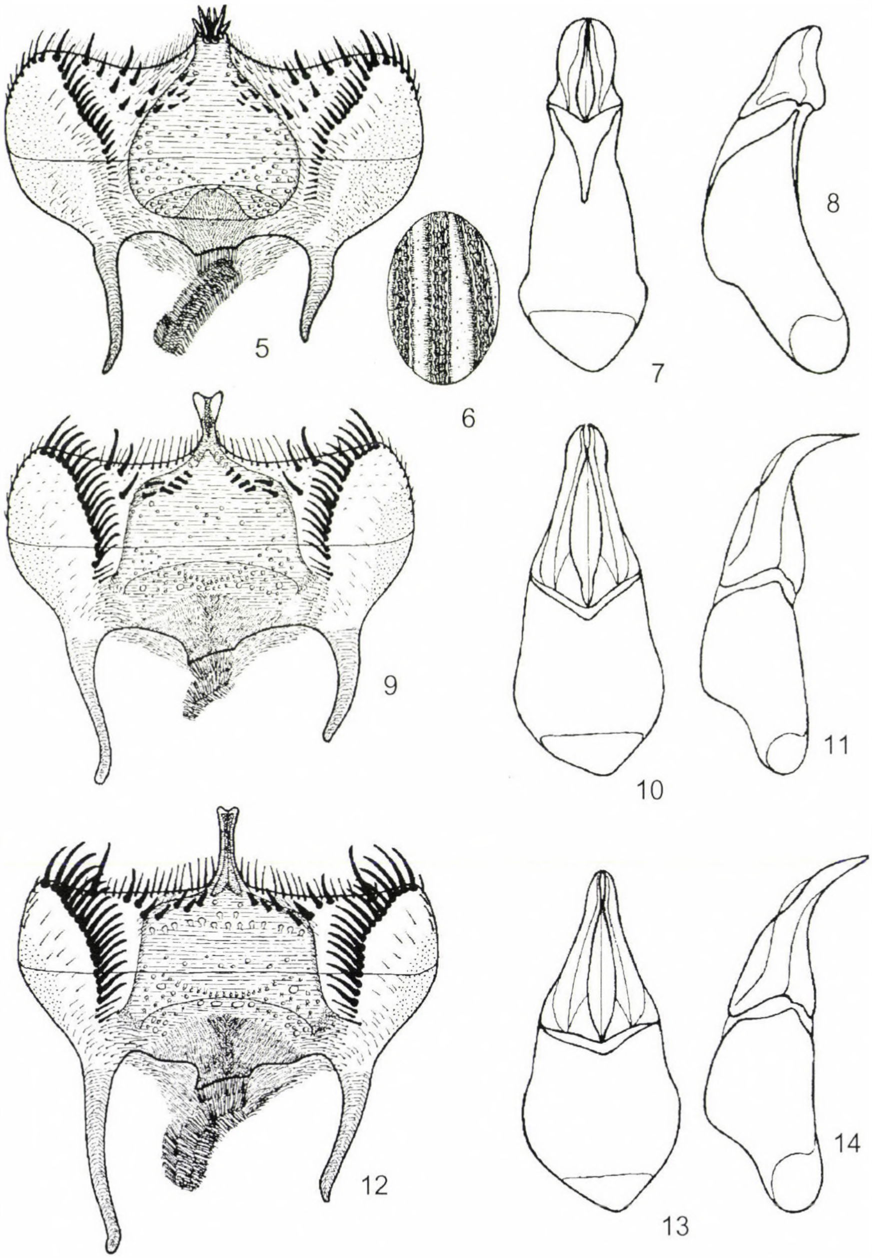
Type depository: BALTHASAR collection, National Museum, Prague.

Type material: Holotype, male, with handwritten locality label: "Thomsk" and printed label "Reitter collection".

Redescription of male – Length 4.0 mm. Oblong, stout, strongly convex, strongly microreticulate thus strongly dull, glabrous (Fig. 1). Blackish, clypeal margin and legs dark brownish; antennal club piceous. Head cupuliform; epistoma strongly microreticulate and indistinctly punctured, anteriorly with a feebly raised transverse short carina; clypeus very feebly sinuate at middle, denticulate at sides, denticles distinctly upturned; genae widely rounded, shortly and sparsely ciliate, faintly protruding more than eyes; frontal suture somewhat more shiny, slightly raised laterally and with a weak median tubercle; frons relatively more superficially microreticulate, regularly and densely punctured; epipharynx: Fig. 5. Pronotum feebly transverse, strongly microreticulate, doubly punctured; larger punctures densely and regularly scattered throughout, mixed much smaller ones; sides thinly bordered, parallel toward base; hind angles obtusely rounded; base faintly bisinuate, thickly bordered. Scutellum with a median carina feebly raised, lateral impressions confusedly irregularly punctured. Elytra shortly oval, sharply denticulate at shoulder; striae wide, rather shiny, strongly impressed, distinctly crenulate, punctures with a small central granule joining each other by a fine carina; interstices feebly convex, strongly microreticulate, sparsely, finely and confusedly punctured, at each side with a superficial striola along the stria (Fig. 6). Fore tibiae with apical spur stout, cylindrical, longer than first two tarsal segments combined, abruptly downward curved toward apex; middle tibiae with inferior apical spur short, obliquely truncate apically. Superior apical spur of hind tibiae nearly as long as inferior one and distinctly shorter than first tarsal segment (other segments lacking in the sole specimen available). Metasternal plate nearly flat, strongly microreticulate, irregularly punctured and with median longitudinal groove shiny and slightly impressed. Aedeagus: Figs 7–8.



Figs 1–4. Habitus of: 1 = *Vladimirellus socors* (BALTHASAR, 1967) (male, length 4.0 mm; Russia: Siberia Thomsk), 2 = *Ahermodontus bishoffi* (VŠETEČKA, 1939) (female, length 4.5 mm; Albania: Logara), 3 = *A. marini* BÁGUENA, 1930 (male, length 4.0 mm; Spain: Castellón, Onda), 4 = *A. ambrosi* PARDO ALCAIDE, 1936 (male, length 4.0 mm; Morocco: Taxdirt, B. Sicar.)



Figs 5–14. *Vladimirellus socors* (BALTHASAR, 1967): 5 = epipharynx, 6 = elytral sculpture, 7–8 = aedeagus (dorsal and lateral view). *Ahermodontus ambrosi* PARDO ALCAIDE, 1936: 9 = epipharynx, 10–11 = aedeagus (dorsal and lateral view). *A. marini* BÁGUENA, 1930: 12 = epipharynx, 13–14 = aedeagus (dorsal and lateral view)

Female unknown.

Distribution: Known only from the holotype from the type locality.

Ahermodontus BÁGUENA, 1930

Ahermodontus BÁGUENA, 1930: 315; BÁGUENA 1959: 214 (as synonym of *Ammoecius*); BALTHASAR 1964: 475; DELLACASA G. & DELLACASA M. 1998: 414; DELLACASA G. *et al.* 2001: 77.
Aphodius (Ahermodontus): BÁGUENA 1967: 122; DELLACASA M. 1988: 221.

Type species: *Ahermodontus marini* BÁGUENA, 1930 (monotypy).

Description – Length 4.0–4.5 mm. Apterous species, rather small, stout, strongly convex, more or less shiny, glabrous. Black, clypeal margin and legs brownish-red; antennal club testaceous. Head wide, cupuliform; epistoma finely or coarsely punctured, anteriorly with strong transverse carina; clypeus faintly sinuate at middle, bidenticulate at each side, inner teeth stronger than outer ones, all teeth more or less strongly upturned, laterally straight and more or less thinly bordered, border glabrous and more or less distinctly upturned; frontal suture nearly faint or distinctly impressed only laterally, not at all tuberculate; genae obtusely rounded, rather ciliate, protruding more than eyes; latter small. Pronotum widely transverse, strongly convex, doubly punctured; larger punctures sparser on disc; finely bordered at front or not; lateral margins thinly bordered, shortly ciliate toward front angles; hind angles obtusely rounded; base bordered or not. Scutellum very small, regularly triangular, feebly convex, unpunctured. Elytra convex, very shiny, oval-elongate; striae deep, strongly punctured, feebly or strongly crenulate; interstices flat or convex, sometimes apically subcarinate, sparsely finely punctured; shoulder strongly denticulate. Fore tibiae distally tridentate and proximally distinctly serrulate at outer margin, upper side smooth. Middle and hind tibiae with strong transverse carinae on outer face, apically fimbriate with short and equal spinules. Pygidium with rather dense and moderately elongate pubescence, mixed toward apical margin some very elongate and straight setae. Sexual dimorphism shown in males by punctation of pronotum being more sparse on disc, by inferior apical spur of mesotibiae strongly shortened and apically subtruncate. Aedeagus with elongate parameres, curved and acuminate apically. Epipharynx widely transverse, feebly bisinuate at front margin; corypha strongly protruding frontwards, apically rounded and sinuate at middle; epitorma campaniform; chaetopariae with rather elongate and densely arranged chaetae; chaetopedia with few strong spines arranged in nearly regular series.

Distribution: SW Palaearctic region (Albania, southern Spain and Spanish Morocco).

KEY TO SPECIES OF AHERMODONTUS BÁGUENA, 1930

1 Base of pronotum not bordered; epistoma finely punctured; elytral interstices flat. Black. Length 4.0 mm. Southern Spain (Castellón and Valencia provinces) *marini* BÁGUENA, 1930

– Base of pronotum distinctly bordered 2

2 Anterior margin of pronotum with thin but distinc border; elytral interstices feebly convex; epistoma coarsely punctured. Black. Length 4.0 mm. Southern Spain (Andalusia), Morocco (Melilla)
ambrosi PARDO ALCAIDE, 1936

– Anterior margin of pronotum not bordered; elytral interstices feebly convex on disc, distinctly convex laterally, subcarinate apically; epistoma finely punctured. Black. Length 4.5 mm. Albania (Logara)
bishoffi (VŠETEČKA, 1939)

Ahermodontus ambrosi PARDO ALCAIDE, 1936
(Figs 4, 9–11)

Ahermodontus ambrosi PARDO ALCAIDE, 1936: 392; BALTHASAR 1964: 476; DELLACASA G. & DELLACASA M. 1998: 415.
Aphodius ambrosi: KOCHER 1958: 17.
Aphodius (Ammoecius) ambrosi: BARAUD 1971: 69.
Aphodius (Ahermodontus) ambrosi: DELLACASA M. 1988: 159; VEIGA 1998: 146.

Type locality: Sidi-Messaud (Beni-Bu-Gafar), Morocco.
Type depository: Institut Scientifique Cherifien, Rabat.

Description – Length 4.0 mm. Stout, strongly convex, shiny, glabrous (Fig. 4). Blackish, clypeal margin and legs brown-reddish, antennal club testaceous. Head large; epistoma faintly gibbous at middle, coarsely, regularly punctured throughout, punctation somewhat confluent laterally, with anterior transverse carina moderately raised in front of which punctation slightly finer and sparser; clypeus feebly sinuate at middle, bidenticulate at each side, laterally straight and thinly bordered, border feebly upturned; genae obtusely rounded, ciliate, protruding more than eyes; frontal suture very finely impressed, shiny; frons with punctation somewhat finer than epistoma; epipharynx: Fig. 9. Pronotum transverse, strongly convex, doubly punctured; larger punctures rather sparse on disc, denser on sides, mixed with regularly scattered, smaller punctures throughout; anterior margin finely bordered; lateral margins subparallel, rather thinly bordered, border with short and sparse setae toward anterior angles; hind angles obtusely rounded; base not bisinuate, thickly bordered. Scutellum faintly convex, finely and sparsely punctured on basal half. Elytra shortly oval, strongly convex, sharply denticulate at shoulder; striae deep, superficially punctured, faintly crenulate; interstices slightly convex, very finely and sparsely punctured. Hind tibiae superior apical spur longer than first tarsal segment; latter somewhat longer than following two combined. Male: pronotum relatively less densely punctured on disc; inferior apical spur of middle tibiae distinctly shortened and obliquely truncate apically; aedeagus: Figs 10–11. Female: pronotum relatively more densely puntured on disc; inferior apical spur of middle tibiae regularly acuminate toward apex.

Distribution: Southern Spain (Andalusia: Malaga), Morocco (Melilla).

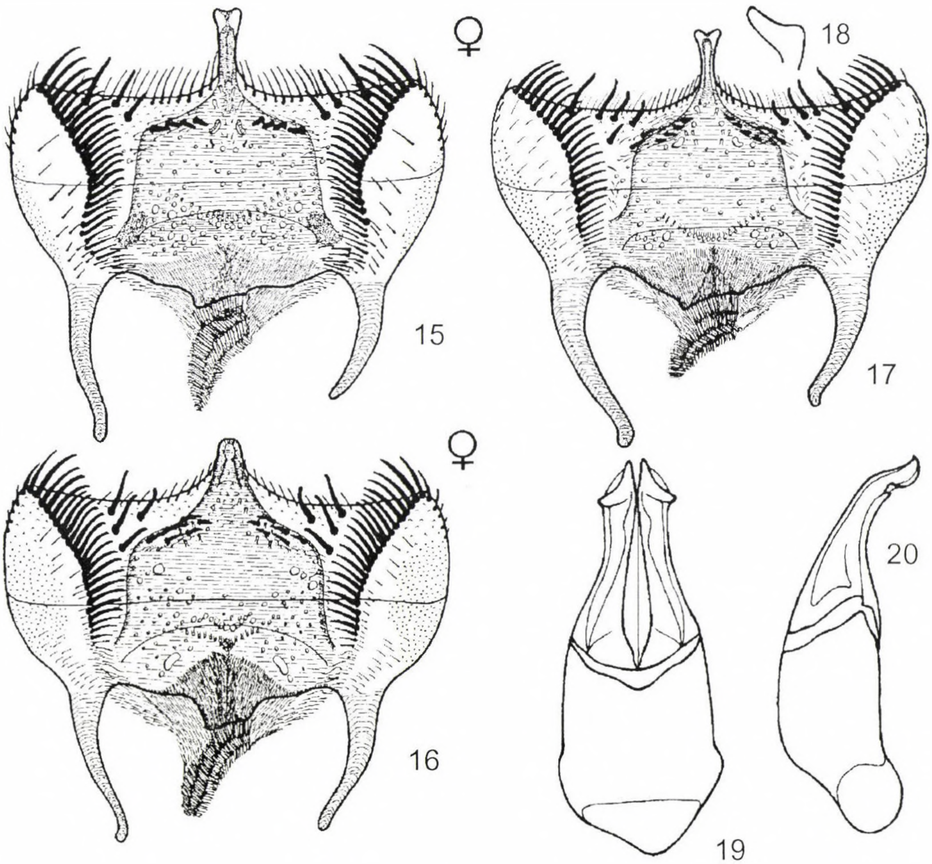
Ahermodontus bischoffi (VŠETEČKA, 1939) (Figs 2, 15)

Aphodius (Ammoecius) bischoffi VŠETEČKA, 1939: 31; BALTHASAR 1964: 79; BARAUD 1971: 69.
Aphodius (Ahermodontus) bischoffi: DELLACASA M. 1988: 99.
Ahermodontus bischoffi: DELLACASA G. & DELLACASA M. 1998: 415.

Type locality: Logara, Albania.

Type depository: BALTHASAR collection, National Museum, Prague.

Type material: We had the opportunity to examine the female holotype, which is, as far as we know, the sole specimen known. It was collected in 1934 by Alfons Bishoff (Tirana) to whom the species was dedicated.



Figs 15–20. 15 = epipharynx of *Ahermodontus bishoffi* (VŠETEČKA, 1939), 16 = epipharynx of *Ammoecius eli* (PETROVITZ, 1961). *A. dogueti* (BARAUD, 1980): 17 = epipharynx, 18 = apex of corypha (lateral view), 19–20 = aedeagus (dorsal and lateral view)

Description of female – Length 4.5 mm. Short, oval, strongly convex, shiny, glabrous (Fig. 2). Blackish; clypeal margin and legs brown-reddish; antennal club reddish-testaceous. Head with epistoma finely microreticulate and almost imperceptibly punctured on disc, laterally with few punctures very large, anteriorly with strong transverse carina in front of which the punctation becomes finely granulose; clypeus quadridentate, inner teeth stronger and more upturned than lateral ones, subtruncate at middle, straight and thinly bordered at sides; genae angulate, rather elongately ciliate, distinctly protruding more than eyes; frontal suture faint; frons somewhat more distinctly punctured than epistomal disc; epipharynx: Fig. 15. Pronotum transverse, strongly convex, doubly punctured, larger punctures irregularly sparse, much denser on sides; much smaller punctures throughout regularly scattered; sides nearly straight, thinly bordered, border shortly and sparsely bristled toward front angles; hind angles obtusely rounded; base not bisinuate at all, very thickly bordered, border distinctly sunken if compared with pronotal surface. Scutellum regularly triangular, slightly convex, impunctate. Elytra strongly convex, feebly broadened backward; sharply denticulate at shoulder; striae large, very deep, coarsely punctured, strongly crenulate; interstices moderately convex on disc, more distinctly convex laterally and subcarinate on preapical declivity, laterally microreticulate, finely sparsely punctured. Hind tibiae superior apical spur as long as first tarsal segment; latter as long as following three combined.

Male unknown.

Distribution: Known only from the type locality.

Ahermodontus marini BÁGUENA, 1930
(Figs 3, 12–14)

Ahermodontus marini BÁGUENA, 1930: 315; BALTHASAR 1964: 476; DELLACASA G. & DELLACASA M. 1998: 415; DELLACASA G. *et al.* 2001: 77.
Ammoecius (Ahermodontus) marini: BÁGUENA 1960: 29.
Aphodius (Ammoecius) marini: BÁGUENA 1959: 214; BARAUD 1971: 64; BARAUD 1992: 146.
Aphodius (Ahermodontus) marini: BÁGUENA 1967: 122; DELLACASA M. 1988: 159.

Type locality: Fuente de Barraix, De Estivella (Valencia), Spain.
Type depository: BÁGUENA collection, Museo de la Universidad de Valencia, Valencia.

Description – Length about 4.0 mm. Stout, strongly convex, shiny, glabrous (Fig. 3). Black, clypeal margin and legs reddish; antennal club testaceous. Head strongly convex, epistoma anteriorly with strong transverse carina, quite finely and regularly punctured, punctation somewhat sparser at center and subrugose laterally; clypeus faintly sinuate at middle, bidenticulate at each side, laterally straight, rather thinly bordered, border feebly upturned; genae obtusely rounded, ciliate, protruding more than eyes; frontal suture very finely impressed, not at all tuberculate; frons regularly punctured; epipharynx: Fig. 12. Pronotum transverse, doubly punctured; larger punctures nearly lacking on disc; finely bordered at front and at lateral margins; latter regularly rounded; base not bordered. Scutellum feebly convex, smooth. Elytra oval-elongate; strongly denticulate at shoulder; deeply striate; striae distinctly punctured, feebly crenulate; interstices nearly flat, very sparsely finely punctured; epipleura strong, distinct to sutural angles. Hind tibiae superior apical spur slightly longer than first tarsal segment; latter longer than following two combined. Male: pronotum relatively less densely punctured on disc; inferior apical spur of middle tibiae strongly shortened and apically subtruncate;

aedeagus: Figs 13–14. Female: pronotum relatively more densely punctured on disc; inferior apical spur of middle tibiae elongate and regularly acuminate apically.

Distribution: Southern Spain (Castellón and Valencia provinces).

Ammoecius MULSANT, 1842

Ammoecius MULSANT, 1842: 302; PAULIAN 1942: 25; ÁDÁM 1994: 13; DELLACASA G. *et al.* 2001: 82.
Aphodius (Ammoecius): REITTER 1892: 183; PAULIAN & BARAUD 1982: 111; DELLACASA G. 1983: 164; DELLACASA M. 1988: 368 (catalogue).
Aphodius (secção *Digonorhinus*): SEABRA 1909: 12; DELLACASA G. *et al.* 2001: 82 (as synonym of *Ammoecius*).
Aphodius (Artengruppe *Ammoecius*): ENDRŐDI 1964: 105.
Aphodius (group *Ammoecius*): ENDRŐDI & RAKOVIČ 1981: 42.

Type species: *Scarabaeus elevatus* OLIVIER, 1789 (monotypy).

Description – Length 3.0–10.0 mm. Small or medium size species, stout or suboval, strongly convex, shiny, glabrous. Black, sometimes elytra reddish, seldom quite reddish. Head cupuliform; epistoma punctured, rarely subrugose anteriorly, always with distinct transverse carina; clypeus usually sinuate at middle, either denticulate or angulate at sides, bordered, border glabrous; genae obtusely rounded, ciliate, protruding more than eyes; latter small; frons without any trace of tubercles. Pronotum strongly convex, sparsely or densely punctured; bordered at sides and usually at base, seldom at front margin. Scutellum small, triangular, punctured. Elytra strongly convex, widened posteriorly, rarely parallel-sided; striae deep or superficial; interstices flat, feebly convex, sometimes distinctly convex apically. Fore tibiae distally tridentate and proximally serrulate at outer margin, upper side with few large superficial punctures irregularly scattered. Middle and hind tibiae with strong transverse carinae on outer face, fimbriate with apical spinules short and equal. Pygidium with fine, rather sparse, short and straight pubescence; its apical margin with dense and moderately elongate cilia. Sexual dimorphism shown in males by more evident epistomal carina and less dense punctation on pronotal disc; by inferior apical spur of middle tibiae shortened and abruptly inwardly bent apically (except in *A. incultus*); by the peculiar shape of fore tibial apical spur (in several taxa); by metasternal plate more deeply excavate. Aedeagus with paramera elongate, apically widened, sinuate or abruptly narrowed; sometimes with membranous processes preapically inserted. Epipharynx distinctly sinuate at front margin; corypha strongly protruding beyond front margin and distinctly sinuate apically; epitorma wide, guttiform; pedia with sparse, stout elongate chaetae, anterior ones hooked; chaetopariae dense and very elongate.

Distribution: Palaearctic and Afrotropical regions.

KEY TO SPECIES OF AMMOECIUS MULSANT, 1842

1	Palaearctic taxa	2
–	Southern Afrotropical taxa	17

2 Clypeus distinctly denticulate or, at least, acutely angulate at sides of median sinuosity 3

– Clypeus nearly rounded or, at most, obtusely angulate at sides of median sinuosity 12

3 Elytral interstices subcarinate on preapical declivity, striae deep, as wide as interstices and with large transverse punctures. Length 5.0 mm. Iraq *eli* (PETROVITZ, 1961)

– Elytral interstices convex or flat but not subcarinate toward apex 4

4 Anterior margin of pronotum not bordered 5

– Anterior margin of pronotum finely bordered 9

5 Shoulder distinctly denticulate 6

– Shoulder not denticulate, at most epipleural carina more or less distinctly angulate at shoulder 7

6 Elytral interstices flat. Length 6.0–6.5 mm. Algeria *dogueti* (BARAUD, 1980)

– Elytral interstices strongly convex. Length 5.5 mm. Syria *naviauxi* (BARAUD, 1971)

7 Fore tibiae with apical spur regularly acuminate toward apex in both sexes; first segment of hind tarsi as long as following three combined. Length 5.0–8.0 mm. Southwestern Europe (from Portugal to northwestern coastal Italy), Northwestern Africa (from Morocco to Libya) *elevatus* (OLIVIER, 1789)

– Fore tibiae with apical spur, in males, digitiform; first segment of hind tarsi somewhat longer than following three combined 8

8 Elytral striae not or faintly crenulate; interstices flat on disc; fore tibiae with apical spur, in males, cylindrical and inwardly faintly hooked at apex. Length 6.0–6.5 mm. Asian Turkey, Greece? *muchei* (PETROVITZ, 1962)

– Elytral striae strongly crenulate; interstices slightly convex on disc; fore tibiae with apical spur, in males, spatulate and slightly broadened apically. Length 6.5–7.5 mm. Southern Turkey *satanas* (CARPANETO, 1976)

9 Pronotal punctation simple, rather fine and regularly scattered. Length 4.0–5.0 mm. Algeria *felscheanus* REITTER, 1904

– Pronotal punctation double, large punctures irregularly scattered 10

10 Epistoma, in front of transverse anterior carina, simply and rather sparsely punctured. Length 4.0–5.0 mm. Southern Portugal and Spain, western Morocco *dentatus* SCHMIDT, 1908

– Epistoma, in front of transverse anterior carina, more or less strongly granulo-rugose 11

11 Larger pronotal punctures irregular and sparse on basal two-thirds of disc; genae not auriculate at all; elytral striae feebly crenulate. Length 4.5–5.0 mm. Algeria, Tunisia, Sicily? *numidicus* MULSANT, 1851

– Larger pronotal punctures irregular and sparse only on basal third of disc; genae auriculate; elytral striae faintly crenulate. Length 5.0–6.0 mm. Morocco *franzi* (PETROVITZ, 1964)

12 Anterior margin of pronotum not bordered or with border widely interrupted at middle 13

– Anterior margin of pronotum finely bordered 16

13 Elytral interstices flat 14

– Elytral interstices more or less strongly convex 15

14 Pronotum extremely transverse, broadened; base of pronotum bordered only up to level of fifth elytral interstice; hind tibiae with superior apical spur feebly longer than first two tarsal segments combined. Length 4.5–5.0 mm. Morocco (Haut Atlas) *amplicollis* (PEYERIMHOFF, 1939)

– Pronotum moderately transverse; basal margin of pronotum bordered; fore tibiae with apical spur digitiform, apically broadly spatulate. Length 5.5–6.5 mm. Azerbaijan, Iran *meurguesae* CLÉMENT, 1975

15 Elytral interstices strongly convex; striae large, very deep, coarsely punctured, strongly crenulate. Length 3.5–4.5 mm. Europe, Asia (Turkmenistan, Mongolia, Siberia) *brevis* ERICHSON, 1848

– Elytral interstices moderately convex; striae rather fine, almost superficially punctured, feebly crenulate. Length 4.5–5.5 mm. Portugal, Spain, Morocco? *frigidus* BRISOUT, 1866

16 Epistoma finely and sparsely punctured on disc. Length 4.5–5.0 mm. Portugal, Spain, Morocco?, Algeria? *lusitanicus* ERICHSON, 1848

– Epistoma coarsely, densely, subrugosely punctured on disc. Length 4.0–5.0 mm. Western Sardinia, Sicily?, Tunisia, Algeria *rugifrons* AUBÉ, 1850

17 Clypeal margin rounded at sides of median sinuosity. Length 4.0–5.0 mm. South Africa (Northern and Western Cape Province) *mimus* (PÉRINGUEY, 1901)

– Clypeal margin acutely angulate or denticulate at sides of median sinuosity 18

18 Pronotal punctation double. Length 3.5–5.0 mm. South Africa (Cape Province, Transvaal?) *lugubris* BOHEMAN, 1857

– Pronotal punctation simple 19

19 Epistomal and pronotal punctation fine and sparse; middle tibiae with inferior apical spur apically acuminate in both sexes. Length 3.0–3.5 mm. South Africa (Western Cape Province) *incultus* (PETROVITZ, 1961)

– Epistomal and pronotal punctation rather coarse and dense; middle tibiae with inferior apical spur, in males, short and abruptly inwardly bent at apex. Length 3.5–5.5 mm. South Africa (Northern and Western Cape Province, Namaqualand) *terminatus* HAROLD, 1869

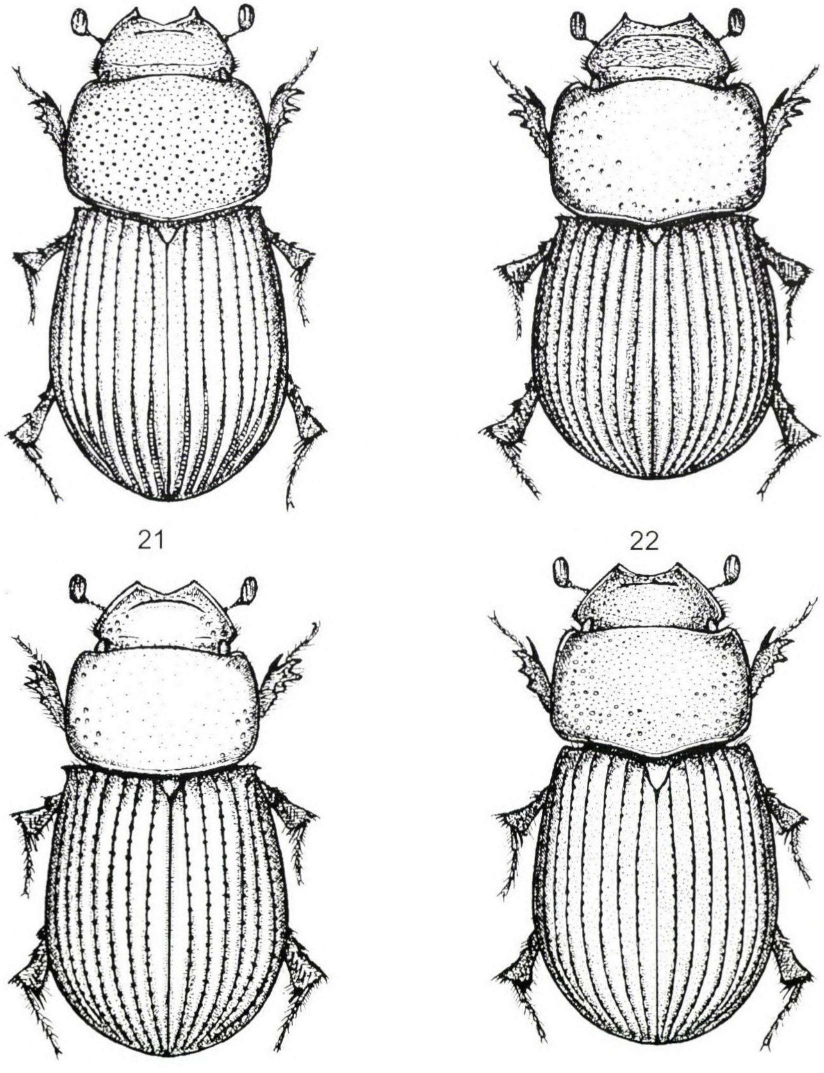
Ammoecius amplicollis (PEYERIMHOFF, 1939), **comb. n.** (Figs 67, 69–72)

Aphodius (Ammoecius) amplicollis PEYERIMHOFF, 1939: 279; BALTHASAR 1964: 81; PETROVITZ 1968: 230; BARAUD 1971: 65; BARAUD 1985: 109; DELLACASA M. 1988: 86.

Type locality: "Massif du Toubkal, Grand-Atlas". [Morocco.]
Type depository: Muséum national d'Histoire naturelle, Paris.

Description – Length 4.5–5.5 mm. Short, oblong, convex, strongly shiny, glabrous (Fig. 67). Black, clypeal margin and legs brown-reddish, antennal club piceous. Head with cupuliform epistoma almost imperceptibly punctured on disc; punctation distinct, very fine and regular laterally and in front of the rather short and feebly curved transverse carina; clypeus angulately sinuate at middle, obtusely angulate at sides, finely bordered, border feebly upturned; genae obtuse, elongately ciliate, distinctly protruding more than eyes; frontal suture finely impressed; frons very finely and sparsely punctured; epipharynx: Fig. 69; apex of corypha: Fig. 70. Pronotum strongly convex, widely transverse, strongly broader than long, smooth on disc, with extremely fine punctation on sides and therein with few very sparse large punctures; anterior margin with lateral vestiges of border; nearly parallel-sided; sides rather thickly bordered and faintly inwardly sinuate before hind angles; latter widely rounded; base not bisinuate, laterally with thin border only to level of fifth elytral interstice.

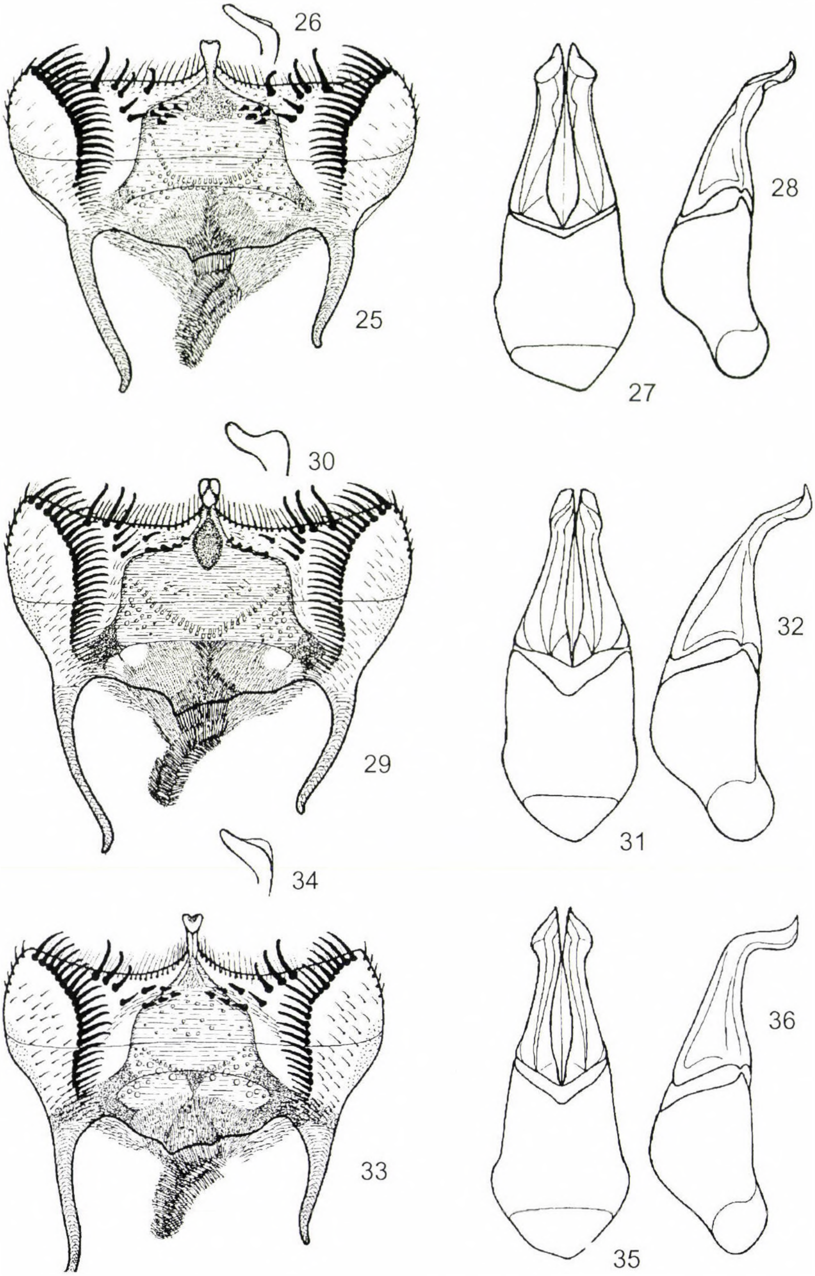
Scutellum very small, regularly triangular, apically rounded, somewhat sunken, smooth. Elytra strongly convex, short, oval, distinctly denticulate at shoulder, rather finely striate; striae superficially punctured, faintly crenulate; interstices nearly flat, imperceptibly punctured. Hind tibiae with



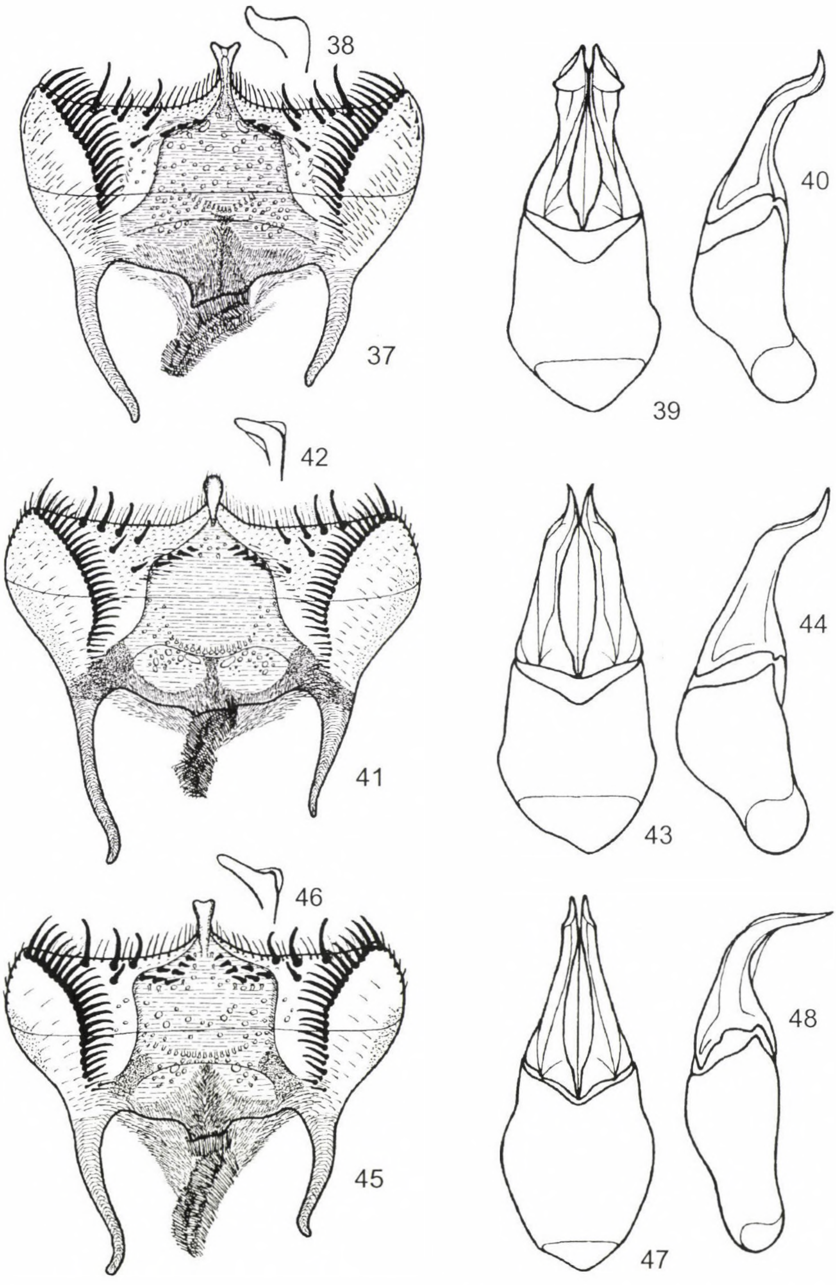
21 22

23 24

Figs 21–24. Habitus of: 21 = *Ammoecius eli* (PETROVITZ, 1961) (female, length 5 mm, Iraq: Mesopotam., Hilleh), 22 = *A naviauxi* (BARAUD, 1971) (male, length 5.5 mm, Syria: Slennfé), 23 = *A. dogueti* (BARAUD, 1980) (male, length 6.0 mm, Algeria: Djurdjura, Chemin lac Goulmine), 24 = *A. elevatus* (OLIVIER, 1789) (male, length 7.0 mm, France: Var, S.te-Baume)



Figs 25–36. Epipharynx (25, 29, 33), apex of corypha (lateral view) (26, 30, 34) and aedeagus (dorsal and lateral view) (27–28, 31–32, 35–36) of: 25–28 = *Ammoecius elevatus* (OLIVIER, 1789), 29–32 = *A. satanas* (CARPANETO, 1976), 33–36 = *A. meurguesae* CLÉMENT, 1975



Figs 37–48. Epipharynx (37, 41, 45), apex of corypha (lateral view) (38, 42, 46) and aedeagus (dorsal and lateral view) (39–40, 43–44, 47–48) of: 37–40 = *Ammoecius naviauxi* (BARAUD, 1971), 41–44 = *A. muchei* (PETROVITZ, 1962), 45–48 = *A. brevis* ERICHSON, 1848

superior apical spur feebly longer than first two tarsal segments; first segment of hind tarsi as long as following three combined. Male: pronotum relatively somewhat less convex; inferior apical spur of middle tibiae very short and phylliform; metasternal plate deeply excavate; aedeagus: Figs 71–72. Female: pronotum relatively more convex; inferior apical spur of middle tibiae elongate and regularly acuminate apically; metasternal plate convex.

Distribution: An endemic species known from Morocco (Haut Atlas) only. Apart from the type locality, it is also known from Arround and Oukaïmeden (2600 m a. s. l.) where we had the chance to collect several specimens in old goat dung in the middle of June.

Ammoecius brevis ERICHSON, 1848
(Figs 45–48, 81)

Ammoecius brevis ERICHSON, 1848: 907; HAROLD 1871: 11.
Aphodius (Ammoecius) brevis: REITTER 1892: 184; d'ORBIGNY 1896: 207; SCHMIDT 1913: 125; SCHMIDT 1922: 68; BALTHASAR 1964: 79; BARAUD 1971: 68; DELLACASA M. 1988: 68.

Type locality: "Im mittleren und südlichen Deutschland". [Germany.]
Type depository: Museum für Naturkunde der Humboldt Universität, Berlin.

Description – Length 3.5–4.5 mm. Short, oval, strongly convex, shiny, glabrous (Fig. 81). Black, clypeal margin faintly brown-reddish; legs piceous with brown-reddish tarsi; antennal club testaceous. Head with cupuliform epistoma finely irregularly microreticulate, thus sericeous, and imperceptibly punctured on disc; punctation laterally somewhat more distinct, irregularly granulose in front of feebly curved anterior transverse carina; clypeus angulately sinuate at middle, obtusely angulate at sides, distinctly bordered, border feebly upturned; genae obtuse, shortly ciliate, protruding more than eyes; frontal suture finely impressed; frons distinctly, finely, and sparsely punctured; epipharynx: Fig. 45; apex of corypha: Fig. 46. Pronotum transverse, somewhat narrower anteriorly, strongly convex, doubly punctured; large punctures deep, irregularly sparse, absent anteriorly on disc, denser on sides, mixed with much smaller, regularly scattered punctures; sides feebly rounded, thinly bordered, faintly inwardly sinuate before the obtusely rounded hind angles; base distinctly bisinuate, bordered. Scutellum regularly triangular, finely punctured at base. Elytra short, strongly convex, backwardly broadened and with epipleural carina subdenticulate at shoulder, deeply striate; striae with large and coarse punctures, strongly crenulate; interstices convex, almost imperceptibly punctured. Hind tibiae with superior apical spur longer than first tarsal segment; latter as long as following three combined. Male: pronotum relatively more transverse, less convex and with large punctures more sparse; middle tibiae with inferior apical spur very short and obliquely truncate apically; metasternal plate feebly concave; aedeagus: Figs 47–48. Female: pronotum relatively less transverse, more convex and with large punctures more densely arranged; middle tibiae with inferior apical spur more elongate and regularly acuminate apically; metasternal plate flat.

Distribution: Widely distributed in Europe (northwards up to Sweden, in south from Spain to Georgia, but absent in southern Italy, Corsica, Sardinia, Sicily, Greece and European Turkey). In Asia, recorded from Turkmenistan, Mongolia and Siberia (Irkutsk region), but absent in Asia Minor.

Ammoecius dentatus SCHMIDT, 1908
(Figs 52, 77–80)

Ammoecius dentatus SCHMIDT, 1908: 504.
Aphodius (Ammoecius) dentatus: SCHMIDT 1913: 126; SCHMIDT 1922: 70; BALTHASAR 1964: 78; BARAUD 1971: 68; DELLACASA M. 1988: 119.

Type locality: "Tanger, Marokko". [Morocco.]
Type depository: Naturhistoriska Riksmuseet, Stockholm.

Description – Length 4.0–5.0 mm. Short, oval, strongly convex, moderately shiny, glabrous (Fig 52). Black, clypeal margin widely brown-reddish; legs brown-reddish with tarsi paler; antennal club testaceous. Head with cupuliform epistoma distinctly, finely, subregularly punctured on disc; laterally mixed with few large punctures; punctation fine and regular in front of short but strongly raised anterior transverse carina; clypeus widely sinuate at middle, sharply denticulate at sides, very thinly bordered, border feebly upturned; genae angulose, elongately ciliate, protruding more than eyes; frontal suture finely impressed; frons finely and subregularly punctured; epipharynx: Fig. 77; apex of corypha: Fig. 78. Pronotum moderately transverse, strongly convex, doubly punctured; large punctures sparser on disc and absent on anterior quarter, mixed with fine punctures regularly scattered throughout; anterior margin finely bordered; sides feebly rounded, distinctly bordered; hind angles obtusely rounded; base not bisinuate, rather thickly bordered. Scutellum regularly triangular, irregularly punctured on basal half. Elytra strongly convex, feebly broadened backward; striae almost fine, superficially punctured, feebly crenulate; interstices very slightly convex with extremely fine sparse punctures. Hind tibiae with superior apical spur longer than first tarsal segment; latter shorter than following three combined. Male: pronotum with large punctures relatively less densely arranged; inferior apical spur of middle tibiae very short, obtusely rounded apically; metasternal plate distinctly concave; aedeagus: Figs 79–80. Female: pronotum with large punctures relatively more densely arranged; inferior apical spur of hind tibiae elongate and regularly acuminate apically; metasternal plate flat.

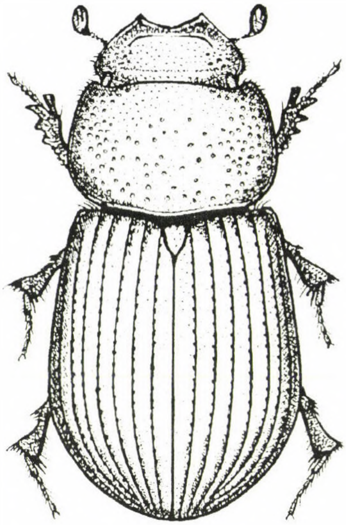
Distribution: Portugal (Algarve), Spain (Andalusia), Morocco (Atlantic coast).

Remarks – Coastal sands seem to be the exclusive habitat of this species.

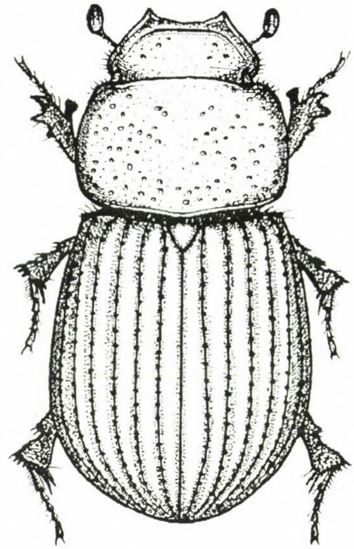
Ammoecius dogueti (BARAUD, 1980), **comb. n.**
(Figs 17–20, 23)

Aphodius (Ammoecius) dogueti BARAUD, 1980: 279; DELLACASA M. 1988: 338.

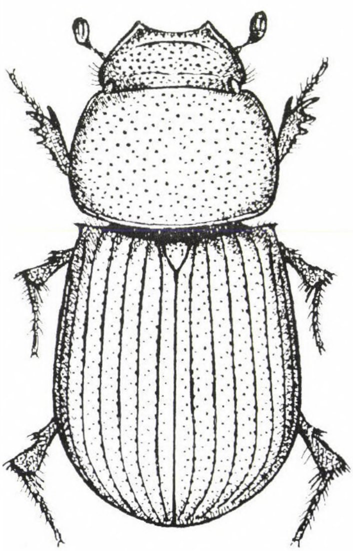
Type locality: Algérie, Djurdjura: Tikdja.
Type depository: BARAUD collection, Muséum national d'Histoire naturelle, Paris.
Material examined: Paratype: Algérie, Djurdjura, Chemin lac Goulmine, 1600 m, 12.07.1979, Maldes J. M. leg. (1 male, BCVLB); allotype: Algérie, Djurdjura, Tikdja, 19.05.1976, Doguet S. leg. (female, MNHNP, BARAUD Coll.).



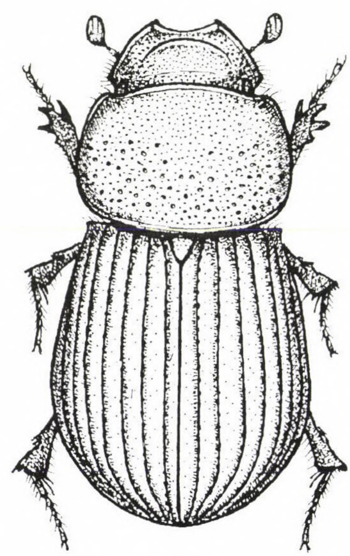
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51



52

Figs 49–52. Habitus of: 49 = *Ammoecius muchei* (PETROVITZ, 1962) (male, length 6.0 mm, Turkey: Vil. Kastamonu, Kastamonu env.), 50 = *A. satanas* (CARPANETO, 1976) (male, length 7.0 mm, Turkey: Vil. Antalya, 40 km S of Akseki, 3 km S Fersin), 51 = *A. felscheanus* REITTER, 1904 (male, length 3.5 mm, Algeria: Oran prov., Oued-Imbert), 52 = *A. dentatus* SCHMIDT, 1908 (male, length 4.0 mm, Morocco: Essaouira)

Description – Length 6.0–6.5 mm. Oblong-elongate, convex, shiny, glabrous (Fig. 23). Black; clypeal margin and legs dark brown-reddish; antennal club testaceous. Head with cupuliform epistoma alutaceous, mostly smooth, only sides with few large punctures, anteriorly with strong transverse carina feebly arcuate, in front of which regularly, finely and granulosely punctured; clypeus widely sinuate at middle, distinctly denticulate at sides, laterally thickly bordered, border slightly upturned; genae obtusely angulate, rather elongately ciliate, distinctly protruding more than eyes; frontal suture shown by finely impressed lateral vestiges only; frons very finely and sparsely punctured; epipharynx: Fig. 17; apex of corypha: Fig. 18. Pronotum broadly transverse, strongly convex, with extremely fine and regularly sparse punctation on disc, only with few large punctures on sides; latter subparallel, distinctly bordered; hind angles widely rounded; base not bisinuate, rather thickly bordered. Scutellum regularly triangular, slightly convex, nearly smooth. Elytra oval-elongate, strongly convex, feebly broadened backward, distinctly denticulate at shoulder; striae deep, coarsely punctured, moderately crenulate; interstices flat on disc, convex laterally and toward apex. Hind tibiae with superior apical spur as long as first tarsal segment; latter as long as following three combined. Male: large punctures on pronotal sides relatively more sparse; inferior apical spur of middle tibiae shortened, obliquely truncate and slightly inwardly hooked apically; aedeagus: Figs 19–20. Female: large punctures on pronotal sides relatively denser; inferior apical spur of middle tibiae rather elongate and regularly acuminate apically.

Distribution: Algeria (Djurdjura massif).

Ammoecius elevatus (OLIVIER, 1789) (Figs 24–28)

Scarabaeus elevatus OLIVIER, 1789: 89.
Aphodius elevatus: FABRICIUS, 1801: 79.
Ammoecius elevatus: MULSANT, 1842: 30; HAROLD 1871: 14; DELLACASA *et al.* 2001: 83.
Aphodius (Ammoecius) elevatus: REITTER 1892: 183; d'ORBIGNY 1896: 205; SCHMIDT 1913: 125; SCHMIDT 1922: 69; BALTHASAR 1964: 77; BARAUD 1971: 66; DELLACASA M. 1988: 124.
Aphodius (Ammoecius) persimilis SCHATZMAYR, 1946: 62; DELLACASA M. 1988: 217 (as doubtful synonym of *numidicus*), **syn. n.**

Type locality: S.te-Baume, Var, France.

Type depository: Muséum national d'Histoire naturelle, Paris.

Type material: *Scarabaeus elevatus* OLIVIER, 1789: **neotype** (male, MNHNP), herewith designated, bearing the following labels: 1) white, printed: VAR, IV. 1982/ S.te-Baume/ Moraguès; 2) red, handwritten: *Scarabaeus elevatus* Olivier, 1789/ Neotypus ♂/ Dellacasa G. & Al. des. 2002; 3) white, handwritten: *Ammoecius/ elevatus* (Olivier, 1789)/ G. Dellacasa & Al., det. 2002.

Aphodius persimilis SCHATZMAYR, 1946: lectotype (male, MCSNM), herewith designated, bearing the following labels: 1) white: Laverdure [printed]/ 7.10.1929 [handwritten]/ Schatzmayr [printed]; 2) white, printed: A. elevatus/ det. Pittino 1979; 3) red, handwritten: Aphodius/ persimilis Schatzmayr, 1946/ lectotypus/ G. & M. Dellacasa des. 2002. Paralectotypes (2 males and 1 female, MCSNM) with the same labels of the lectotype. Paralectotype (1 female, MCSNM), bearing the following labels: 1) white: Laverdure [printed]/ 7.10.1929 [handwritten]/ Schatzmayr [printed]; 2) white, handwritten: sbp. persimilis/ Schatzm.; 3) white, printed: A. elevatus/ det. Pittino 1979; 4) red, handwritten: Aphodius/ persimilis Schatzmayr, 1946/ paralectotypus/ G. & M. Dellacasa des. 2002.

Description – Length 5.0–8.0 mm. Oblong-elongate, convex, shiny, glabrous (Fig. 24). Black, clypeal margin brown-reddish; legs dark brownish with tarsi paler; antennal club testaceous; sometimes ventral side and legs reddish and, more rarely, elytra brown-reddish also. Head with cupuliform epistoma rather finely and irregularly punctured on disc; punctation laterally coarser and irregularly granulose in front of transverse anterior carina; clypeus widely sinuate at middle, distinctly denticulate at sides, thickly bordered, border upturned; genae obtuse, elongately ciliate, distinctly protruding more than eyes; frontal suture finely impressed; frons sparsely punctured; epipharynx: Fig. 25; apex of corypha: Fig. 26. Pronotum broadly transverse, moderately convex, doubly punctured; large punctures deep, sparse on disc, denser on sides, mixed much finer punctures regularly scattered; anterior margin finely bordered to level of eyes; sides subparallel, thinly bordered; hind angles obtusely rounded; base feebly bisinuate, thickly bordered. Scutellum regularly triangular, somewhat convex, with few punctures very fine and irregularly sparse. Elytra oval-elongate, strongly convex, feebly backwardly broadened and with epipleural carina subdenticulate at shoulder; striae deep, coarsely punctured, distinctly crenulate; interstices flat on disc, moderately convex on preapical declivity, almost imperceptibly punctured. Hind tibiae with superior apical spur as long as first tarsal segment; latter as long as following three combined. Male: pronotum relatively more transverse, less convex and with large punctures more sparse; inferior apical spur of middle tibiae short, stout and inwardly curved apically; aedeagus: Figs 27–28. Female: pronotum relatively less transverse, more convex and with large punctures more dense; inferior apical spur of middle tibiae rather elongate and regularly acuminate apically.

Infraspecific names: Morpha: *edentulus* MULSANT, 1842 (= *chobauti* BÁGUENA, 1927; = *corellai* BALTHASAR, 1941): clypeal denticles, at sides of median sinuosity, notably reduced. Colour variation: *fusciventris* MULSANT, 1842: ventral side, legs and sometimes elytra brown-reddish.

Distribution: Southwestern Europe: Portugal, Spain, southern France, northwestern Italy (western Liguria); Mediterranean Africa (Morocco, Algeria, Tunisia, Libya).

Ammoecius eli (PETROVITZ, 1961), **comb. n.**
(Figs 16, 21)

Aphodius (Ammoecius) eli PETROVITZ, 1961: 347; BARAUD 1971: 67; DELLACASA M. 1988: 231.

Type locality: "Hilleh, Mesopotam." [Iraq.]
Type depository: Muséum d'Histoire naturelle, Geneva.

Description of female – Length 5.0 mm. Short, oval, strongly convex, shiny, glabrous (Fig. 21). Blackish, head and pronotum sides shadowy brown-reddish; legs piceous; antennal club testaceous. Head with cupuliform epistoma distinctly, rather sparsely and subregularly punctured on disc, punctures laterally relatively larger; punctation granulo-rugose in front of short and distinctly raised anterior carina; clypeus angulately sinuate at middle, sharply denticulate at sides; denticles distinctly upturned, rather thickly bordered, border feebly upturned; genae obtusely rounded, elongately ciliate, feebly protruding more than eyes; frontal suture finely impressed; frons regularly distinctly punctured; epipharynx: Fig. 16. Pronotum moderately transverse, strongly convex, doubly subregularly punctured; larger punctures absent on anterior quarter, denser on sides; latter feebly rounded, distinctly bordered; hind angles widely rounded; base thickly bordered. Scutellum flat, with

few fine and sparse punctures on basal half. Elytra strongly convex, regularly oval, with small humeral denticle; striae rather fine and distinctly crenulate to preapical declivity wherein they are deep, not crenulate by large transverse punctures and as wide as interstices; latter faintly convex and sparsely punctured on disc, narrower and subcarinate preapically. Metasternal plate nearly flat, finely punctured. Hind tibiae with superior apical spur slightly shorter than first tarsal segment; latter shorter than following two combined.

Male unknown.

Distribution: Known only from type locality of the female holotype.

Remarks – We suspect that this taxon is a junior synonym of *Ammoecius lugubris* BOHEMAN, 1857 from South Africa, but we refrain from proposing a new synonymy because no male specimens have been studied.

Ammoecius felscheanus REITTER, 1904 (Figs 51, 73–76)

Ammoecius felscheanus REITTER, 1904: 255.
Aphodius (Ammoecius) felscheanus: SCHMIDT 1913: 126; BALTHASAR 1964: 78; BARAUD 1971: 68; DELLACASA M. 1988: 231.

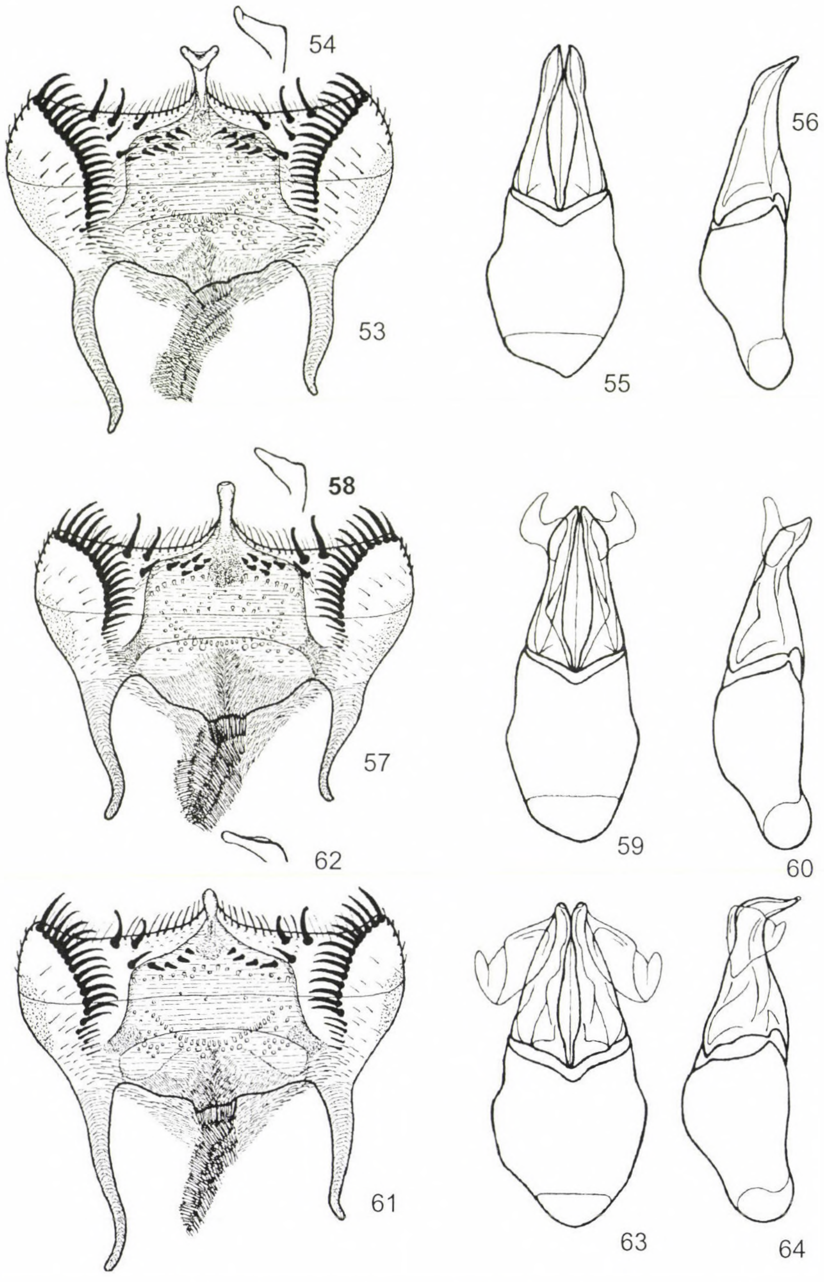
Type locality: "Algier". [Algeria.]

Type depository: Hungarian Natural History Museum, Budapest.

Material examined: Holotype, male and 7 paratypes (3 males, 4 females): Algier, Reitter coll. (HNHMB); 1 male: Oued-Imbert, Oran Prov., Algerie (DCG).

Description – Length 3.5–4.0 mm. Short, oblong, strongly convex, shiny, glabrous (Fig. 51). Blackish; head toward clypeal margin shadowy reddish; legs brown-reddish; antennal club testaceous. Head with epistoma coarsely and subregularly punctured throughout, punctation somewhat finer in front of strongly raised transverse anterior carina; clypeus widely and distinctly sinuate at middle, subdenticulate at sides, thinly bordered; genae obtusely rounded, shortly ciliate, feebly protruding more than eyes; frontal suture finely impressed; frons coarsely and regularly punctured; epipharynx: Fig. 73; apex of corypha: Fig. 74. Pronotum transverse, strongly convex, simply, rather coarsely and regularly punctured, punctation somewhat denser laterally and mainly toward anterior angles; sides feebly rounded, very thinly bordered; hind angles widely rounded; base not bisinuate, distinctly bordered. Scutellum triangularly elongate with curved sides, sparsely and irregularly punctured on basal third. Elytra strongly convex, feebly broadened backward; shoulder with a very small denticle; striae fine, superficially punctured, faintly crenulate; interstices flat, rather sparsely but very distinctly punctured. Hind tibiae with superior apical spur slightly longer than first tarsal segment; latter longer than following two combined; aedeagus: Figs 75–76. Male: inferior apical spur of middle tibiae very short and obliquely truncate apically; metasternal plate concave. Female: inferior apical spur of middle tibiae normally shaped; metasternal plate flat.

Distribution: Algeria.



Figs 53–64. Epipharynx (53, 57, 61), apex of corypha (lateral view) (54, 58, 62) and aedeagus (dorsal and lateral view) (55–56, 59–60, 63–64) of: 53–56 = *Ammoecius rugifrons* AUBÉ, 1850, 57–60 = *A. lusitanicus* ERICHSON, 1848, 61–64 = *A. frigidus* BRISOUT, 1866

Ammoecius franzi (PETROVITZ, 1964), **comb. n.**
(Figs 66, 85–88)

Aphodius (Ammoecius) franzi PETROVITZ, 1964: 185; PETROVITZ 1968: 230 (male description); BARAUD 1971: 62; DELLACASA M. 1988: 131.

Type locality: "Hoher Atlas, Ostseite, Circle de Jaffar". [Morocco.]
Type depository: FRANZ H. collection, Wien.

Description – Length 5.0–6.0 mm. Oblong, strongly convex, shiny, glabrous (Fig. 66). Black; clypeal margin and legs brownish; antennal club dark testaceous. Head with cupuliform epistoma finely, distinctly and rather densely punctured; punctation somewhat denser laterally and almost irregular granulo-rugose in front of the rather short and moderately raised anterior transverse carina; clypeus subtriangularly sinuate at middle, subdenticulate at sides, latter distinctly bordered and regularly arcuate to genae that are feebly but distinctly auriculate, obtusely rounded, elongately ciliate and protruding more than eyes; frontal suture distinct, finely impressed; frons finely and subregularly punctured, punctures somewhat sparser and coarser than those on epistoma; epipharynx: Fig. 85; apex of corypha: Fig. 86. Pronotum moderately transverse, strongly convex, doubly punctured; larger punctures irregularly and sparsely scattered only on basal third of disc; much smaller ones regularly and densely sparse throughout, punctation slightly denser on sides; latter feebly arcuate, distinctly bordered; anterior margin finely bordered; hind angles obtusely rounded; base feebly bisinuate, distinctly bordered. Scutellum flat, finely and sparsely punctured near base. Elytra oval-elongate, strongly convex, not denticulate at shoulder; striae fine, faintly crenulate; interstices nearly flat, sparsely and almost imperceptibly punctured. Hind tibiae with superior apical spur distinctly longer than first tarsal segment; latter somewhat longer than following three combined. Male: inferior apical spur of middle tibiae shortened, apically truncate and inwardly abruptly bent; metasternal plate incavate; aedeagus: Figs 87–88. Female: inferior apical spur of middle tibiae elongate and regularly acuminate toward apex; metasternal plate nearly flat.

Distribution: Morocco (Haut Atlas, Moyen Atlas)

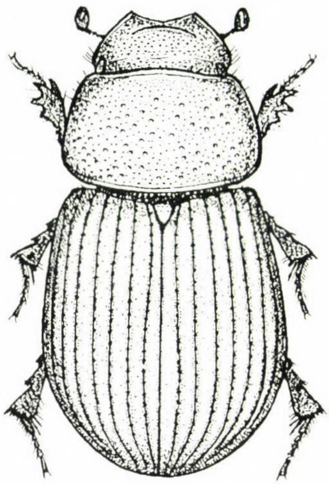
Ammoecius frigidus BRISOUT, 1866
(Figs 61–64, 82)

Ammoecius frigidus BRISOUT, 1866: 374; HAROLD 1871: 15.
Aphodius (Ammoecius) frigidus: REITTER 1892: 184; d'ORBIGNY 1896: 206; SCHMIDT 1913: 125; SCHMIDT 1922: 68; BALTHASAR 1964: 80; BARAUD 1971: 68; DELLACASA M. 1988: 132.

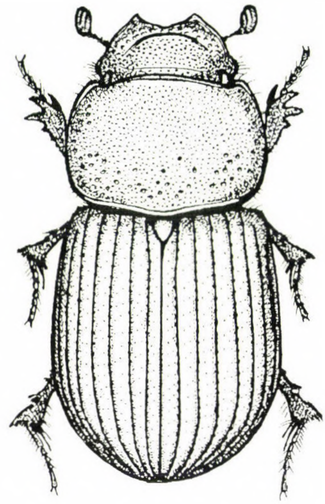
Type locality: "montagne de l'Escorial, La Granja". [Spain.]
Type depository: Muséum national d'Histoire naturelle, Paris.

Description – Length 4.5–5.5 mm. Short, oval, strongly convex, shiny, glabrous (Fig. 82). Black; clypeal margin widely brown-reddish; legs piceous with brownish tarsi; antennal club testaceous. Head with cupuliform epistoma finely microreticulate, almost imperceptibly punctured on disc; punctation more distinct, somewhat irregular laterally and irregular granulate in front of an-

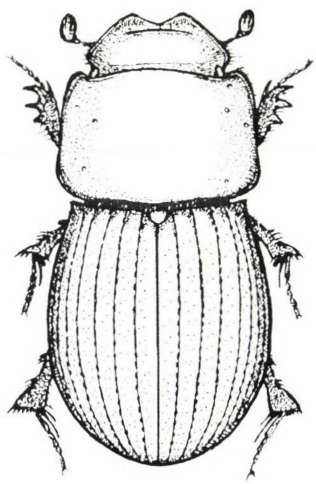
terior transverse carina; latter extended to level of genae; clypeus angulately sinuate at middle, obtusely rounded at sides, rather thickly bordered, border anteriorly upturned; genae obtusely rounded, rather shortly ciliate, feebly protruding more than eyes; frontal suture distinctly impressed; frons finely, subregularly and sparsely punctured; epipharynx: Fig. 61; apex of corypha: Fig. 62. Pronotum



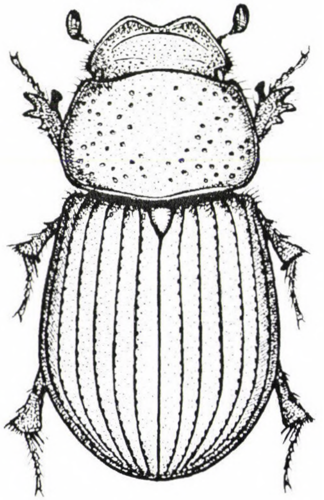
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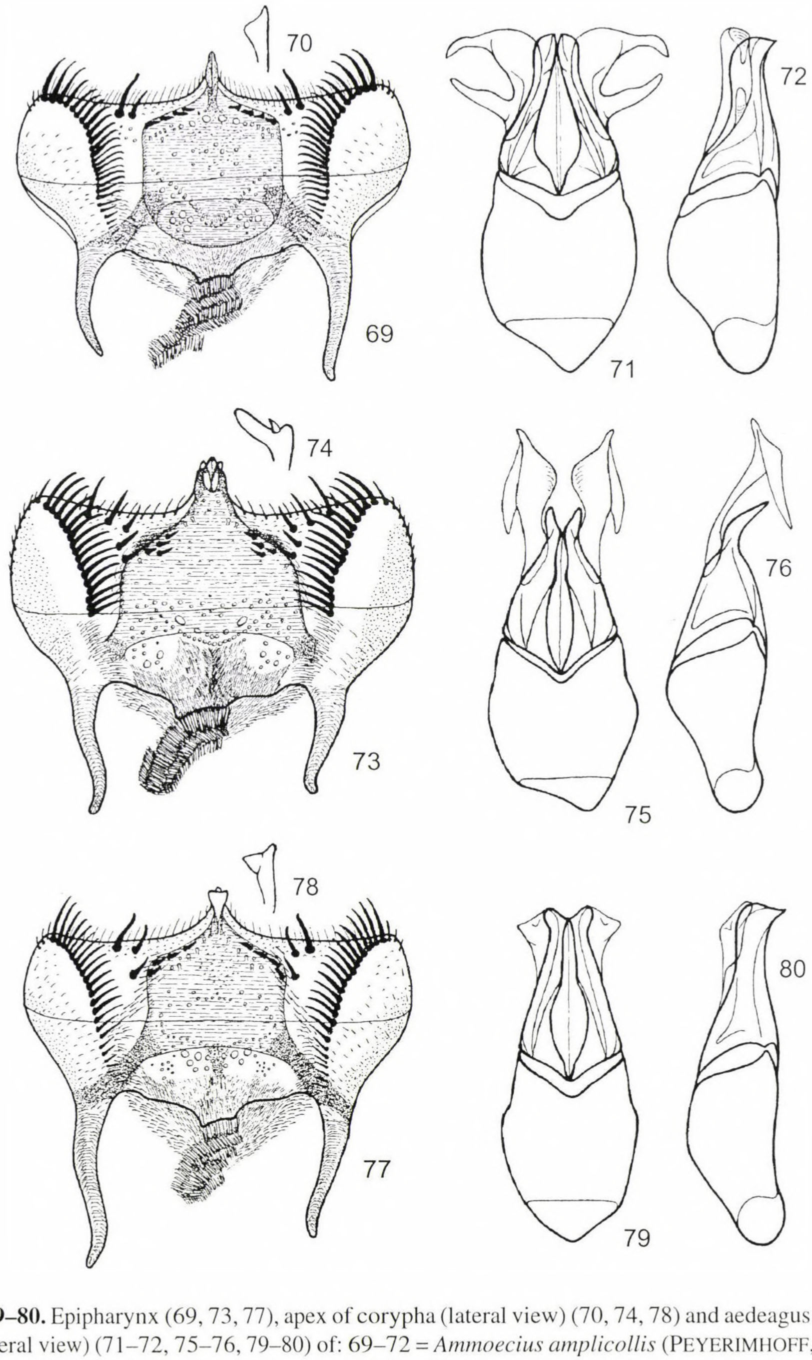


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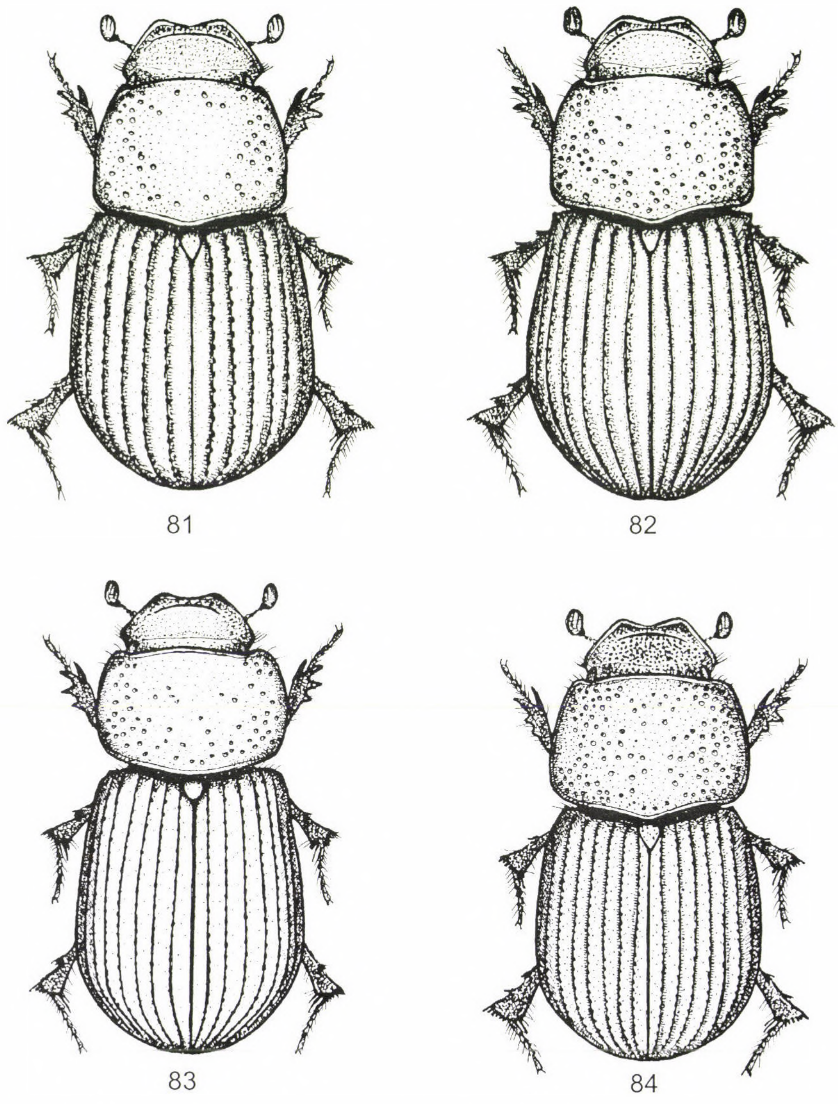
68

Figs 65–68. Habitus of: 65 = *Ammoecius numidicus* MULSANT, 1851 (male, length 4.5 mm, Algeria: Mahouna), 66 = *A. franzi* (PETROVITZ, 1964) (male, length 5.5 mm, Morocco: Oukaïmeden), 67 = *A. amplicollis* (PEYERIMHOFF, 1939) (male, length 5.0 mm, Morocco: Oukaïmeden), 68 = *A. meurguesae* CLÉMENT, 1975 (male, length 6.0 mm, Iran: Mandaran, Gachsar, Hezar Cin Mount)

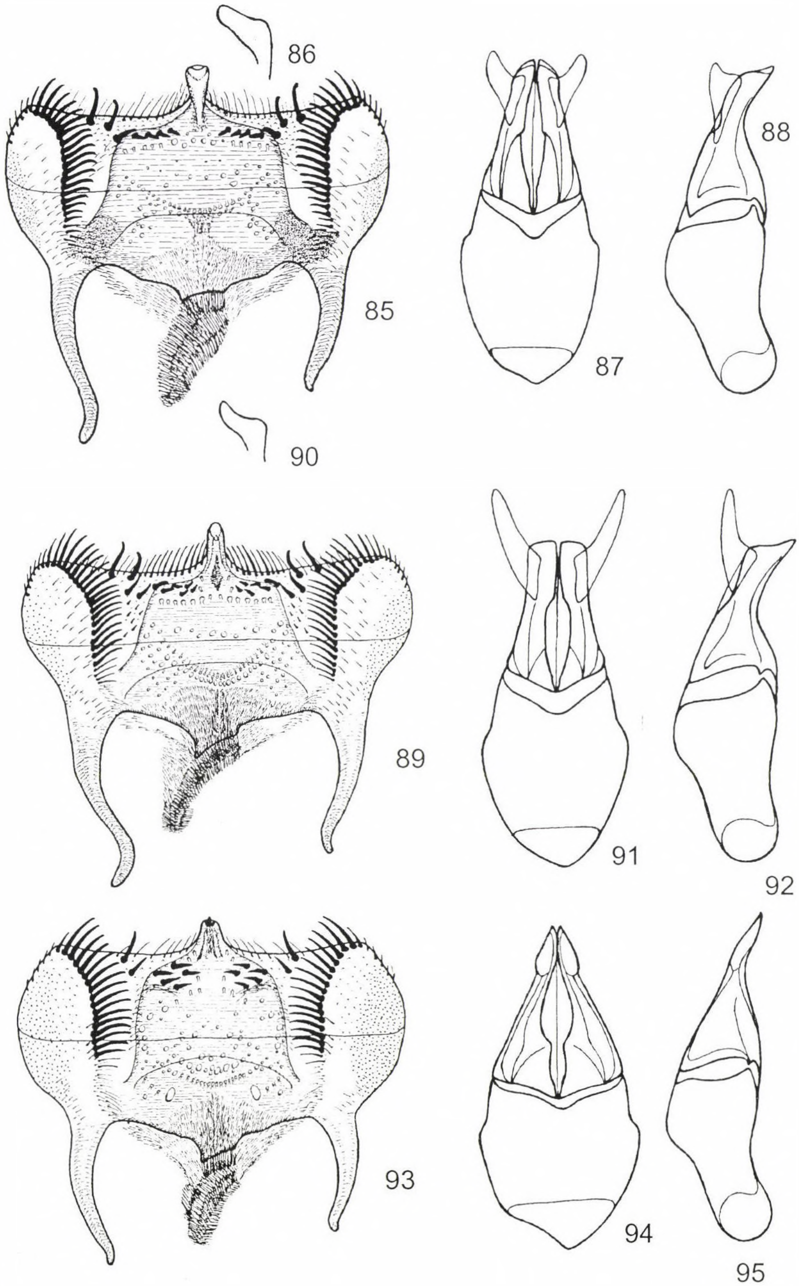


Figs 69–80. Epipharynx (69, 73, 77), apex of corypha (lateral view) (70, 74, 78) and aedeagus (dorsal and lateral view) (71–72, 75–76, 79–80) of: 69–72 = *Ammoecius amplicollis* (PEYERIMHOFF, 1939), 73–76 = *A. felscheanus* REITTER, 1904, 77–80 = *A. dentatus* SCHMIDT, 1908

transverse, moderately convex, doubly punctured; large punctures irregularly sparse, denser on sides, mixed very fine punctures almost imperceptible anteriorly on disc; anterior margin with lateral vestiges of fine border; sides feebly rounded, thinly bordered, somewhat inwardly sinuate before hind angles; latter obtusely rounded; base bisinuate, thickly bordered. Scutellum triangularly elongate,



Figs 81–84. Habitus of: 81 = *Ammoecius brevis* ERICHSON, 1848 (male, length 4.0 mm, Italy: Piedmont, Ghislarengo), 82 = *A. frigidus* BRISOUT, 1866 (male, length 5.0 mm, Portugal: Castelo Branco, Covilhã, Beida Baixa), 83 = *A. lusitanicus* ERICHSON, 1848 (male, length 5.0 mm, Spain: Cadiz, Sierra de Aljibe), 84 = *A. rugifrons* AUBÉ, 1850 (male, length 4.5 mm, Algeria: Mechroha)



Figs 85–95. Epipharynx (85, 89, 93), apex of corypha (lateral view) (86, 90) and aedeagus (dorsal and lateral view) (87–88, 91–92, 94–95) of: 85–88 = *Ammoecius franzi* (PETROVITZ, 1964), 89–92 = *A. numidicus* MULSANT, 1851, 93–95 = *A. incultus* (PETROVITZ, 1961)

sparsely and irregularly punctured on basal half. Elytra strongly convex, feebly broadened backward; epipleural carina subdenticulate at shoulder; striae deep, distinctly punctured, rather feebly crenulate; interstices slightly convex on disc, more distinctly convex on preapical declivity, almost imperceptibly punctured. Hind tibiae with superior apical spur longer than first tarsal segment; latter nearly as long as following three combined. Male: pronotum relatively more transverse, less convex and with large punctures sparser on disc; inferior apical spur of middle tibiae very short, obliquely truncate apically; metasternal plate moderately excavate; aedeagus: Figs 63–64. Female: pronotum relatively less transverse, more convex and with large punctures denser on disc; inferior apical spur of middle tibiae regularly elongate and apically acuminate; metasternal plate flat.

Infraspecific name: colour variation – *galaicus* (BÁGUENA, 1955): upper side chestnut-brown; ventral side reddish.

Distribution: Portugal, Spain, Morocco?

Remarks – The species is also cited from Morocco, but we have never studied specimens collected there.

Ammoecius incultus (PETROVITZ, 1961), **comb. n.** (Figs 93–96)

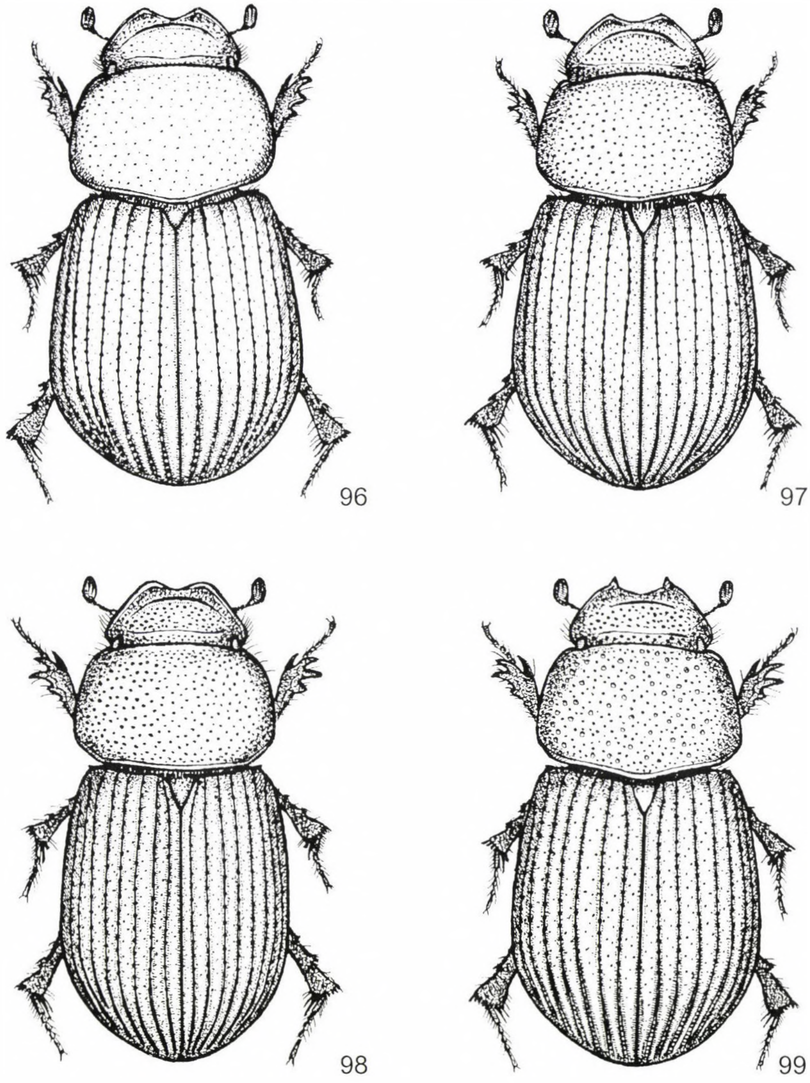
Aphodius (Ammoecius) incultus PETROVITZ, 1961: 349; PETROVITZ 1964: 188; ENDRŐDI 1978: 180 (as synonym of *lugubris*); ENDRŐDI & RAKOVIČ 1981: 42 (as synonym of *lugubris*); DELLACASA M. 1988: 143.

Type locality: "Südafrika: zwischen Middleburg and Cradock". [South Africa.]
Type depository: Naturhistorisches Museum, Basel.

Description – Length 3.0–3.5 mm. Oblong-oval, convex, shiny, glabrous (Fig. 96). Piceous-blackish, clypeal margin and sometimes anterior margin of pronotum and elytra brown-reddish; legs brown-reddish; antennal club dark testaceous. Head with cupuliform epistoma simply, finely and sparsely punctured to the strong, sharply raised and laterally widened anterior carina in front of which the punctation is finely and sparsely granulo-rugose; epistomal disc relatively more sparsely punctured; clypeus deeply triangularly sinuate at middle, subdenticulate at sides, latter finely bordered and broadly rounded; genae obtusely rounded, elongately ciliate, feebly protruding more than eyes; frontal suture distinctly impressed; frons finely and very sparsely punctúred; epipharynx: Fig. 93. Pronotum transverse, strongly convex, simply, sparsely and suregularly punctured, punctation on disc somewhat coarser than that on head, faintly denser on sides; latter feebly curved, rather thinly bordered, with maximum width after half; hind angles rounded; base slightly bisinuate, distinctly bordered. Scutellum almost regularly triangular, at base as wide as two first elytral interstices, smooth. Elytra regularly oval, strongly convex, faintly denticulate at shoulder; striae fine and feebly crenulate on disc, widened and superficially punctured preapically; interstices flat, finely and sparsely punctured on disc, feebly convex and almost imperceptibly punctured on preapical declivity. Middle tibiae with inferior apical spur elongate and regularly acuminate toward apex in both sexes. Hind tibiae with superior apical spur nearly as long as first tarsal segment; latter as long as fol-

lowing three combined. Male: metasternal plate relatively more distinctly excavate; aedeagus: Figs 94–95. Female: metasternal plate nearly flat.

Distribution: South Africa (Western Cape Province)



Figs 96–99. Habitus of: 96 = *Ammoecius incultus* (PETROVITZ, 1961) (male, length 3.0 mm, South Africa: S. W. Cape, Gansbaa 10 km NE), 97 = *A. terminatus* HAROLD, 1869 (male, length 3.5 mm, South Africa: S. W. Cape, Brackfontein farm), 98 = *A. mimus* (PÉRINGUEY, 1901) (male, length 4.5 mm, South Africa: Cape, Karroo, Olifantsulei farm), 99 = *A. lugubris* BOHEMAN, 1857 (male, length 4.0 mm, South Africa: Cap of Good Hope)

Remarks – This species was keyed by PETROVITZ (1964: 188) in the couplet including *Ammoecius lugubris*. ENDRŐDI (1978: 180) established the synonymy of *A. incultus* under *A. lugubris* without giving any justification for the nomenclatorial act. ENDRŐDI & RAKOVIČ (1981: 42) followed this interpretation. All of this seems to be the consequence of HAROLD's misinterpretation of the taxa. Based on the study of a paratype of *A. incultus* preserved in the Geneva Museum by P. BORDAT, we are able to restore it as *bona species*.

Ammoecius lugubris BOHEMAN, 1857
(Figs 99, 103–105)

Ammoecius lugubris BOHEMAN, 1857: 364.
Ammoecius bidentulus HAROLD, 1871: 19; DELLACASA M. 1988: 97, **syn. n.**
Aphodius (Ammoecius) dentinus PÉRINGUEY, 1901: 410; DELLACASA M. 1988: 119, **syn. n.**
Aphodius (Ammoecius) lugubris: PÉRINGUEY, 1901: 409: SCHMIDT 1922: 69; PETROVITZ 1964: 188; ENDRŐDI 1978: 179; ENDRŐDI & RAKOVIČ 1981: 42; DELLACASA M. 1988: 156.

Type locality: "Cap B. Spei". [Cape of Good Hope, South Africa.]

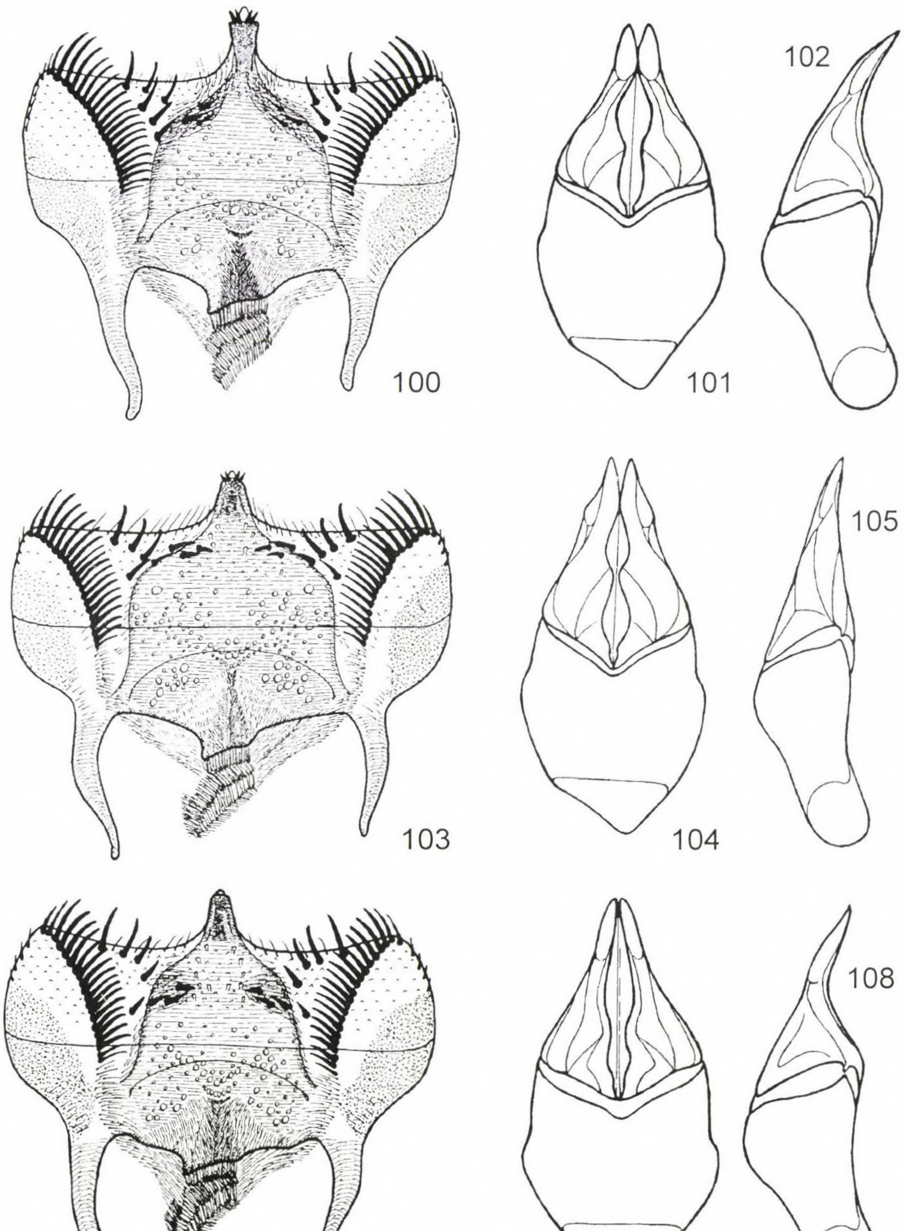
Type depository: Naturhistoriska Riksmuseet, Stockholm.

Type material: *Ammoecius lugubris* BOHEMAN, 1857: **lectotype** (female, NRS), herewith designated, bearing the following labels: 1) white, printed: Cap. B Spei; 2) white, printed: Victorin.; 3) white, printed: Type; 4) red, printed: Typus; 5) red, printed: 53; 6) blue, printed: Naturhistoriska Riksmuseet Stockholm; 7) red, handwritten: *Ammoecius lugubris* Boheman, 1857, lectotype ♀, P. Bordat des. 1993.

Ammoecius bidentulus HAROLD, 1871: **lectotype** (male, MNHNP), herewith designated, bearing the following labels: 1) white, handwritten: W; 2) white, handwritten: Schfuss [Schauffuss] N. 26; 3) white, handwritten: Cap. Bon sp.; 4) white, handwritten by Harold: *bidentulus* (Klug) Harold; 5) white, printed: Ex Musaeo E. Harold; 6) red, handwritten: *Ammoecius bidentulus* Harold, 1871, lectotype ♂, P. Bordat des. 1993.

Ammoecius dentinus (PÉRINGUEY, 1901): type, from "Potchefstr." [Potchefstroom, Transvaal] (sex not identified, SAMCT).

Description – Length 3.5–5.0 mm. Oblong-oval, convex, shiny, glabrous (Fig. 99). Piceous, clypeal and lateral margin of pronotum more or less distinctly reddish; legs brown-reddish; antennal club dark testaceous. Head with cupuliform epistoma simply, subregularly and rather coarsely punctured to the feebly raised and almost short anterior carina in front of which punctation is finely granulose with mixed small punctures; clypeus triangularly and rather deeply sinuate at middle, strongly denticulate at sides, denticles strongly upturned, very thinly bordered and widely rounded laterally; genae obtusely rounded, rather elongately and sparsely ciliate, protruding more than eyes; frontal suture finely impressed, laterally faint; frons coarsely punctured, punctures somewhat larger than on epistoma; epipharynx: Fig. 103. Pronotum transverse, strongly convex, doubly punctured, small punctures regularly scattered thoughout, large punctures, three to five times larger than small ones, irregularly sparse on disc, denser on sides; latter feebly curved, finely bordered, with maximum width near base; hind angles obliquely subtruncate; base faintly bisinuate, distinctly bordered.



Figs 100–108. Epipharynx (100, 103, 106) and aedeagus (dorsal and lateral view) (101–102, 104–105, 107–108) of: 100–102 = *Ammoecius mimus* (PÉRINGUEY, 1901), 103–105 = *A. lugubris* BOHEMAN, 1857, 106–108 = *A. terminatus* HAROLD, 1869

Scutellum triangularly elongate, at base as wide as two first elytral interstices, sparsely punctured on basal third. Elytra convex, moderately broadened backward and with very small humeral tooth; striae rather fine and crenulate on disc, deeper, wider, transversely punctured but not crenulate preapically; interstices feebly convex and finely punctured on disc, subcarinate at middle and narrowly explanate at each side near striae at elytral apex. Hind tibiae with superior apical spur somewhat longer than first tarsal segment; latter somewhat shorter than following three combined. Male: inferior apical spur of middle tibiae short, abruptly inwardly curved apically; aedeagus: Figs 104–105. Female: inferior apical spur of middle tibiae rather elongate and regularly acuminate toward apex.

Distribution: South Africa (Western and Southern Cape Province, Transvaal?).

Remarks – HAROLD (1871: 19) synonymized *Ammoecius terminatus* HAROLD, 1869 under *Ammoecius lugubris* BOHEMAN, 1857, based only on the original description of *A. lugubris*. Study of types of both taxa shows that they are two different species. On the other hand, *Ammoecius bidentulus,* described by HAROLD in the same paper (1871: 19), falls into synonymy with *A. lugubris*. SCHMIDT (1922) followed HAROLD's decision.

As *Ammoecius terminatus* is a good species, notable modifications happen to the interpretation of Afrotropical *Ammoecius*. For example, PÉRINGUEY (1901: 419), when placing *A. terminatus* among the species unknown to him or not surely identifiable, noted that it differs from *A. lugubris* by coarser punctation of head, clypeal carina more raised and not shortened, the elytral striae less convex toward apex and therefore described *Aphodius (Ammoecius) dentinus*.

Recent authors dealing with these taxa followed HAROLD's misinterpretation of *A. terminatus* and *A. lugubris* and, applying HAROLD's incorrect identification key, described several new species consistently increasing the number of Afrotropical *Ammoecius* taxa.

Ammoecius lusitanicus ERICHSON, 1848
(Figs 57–60, 83)

Ammoecius lusitanicus ERICHSON, 1848: 908; HAROLD 1871: 13.
Aphodius (Ammoecius) lusitanicus: REITTER 1892: 184; d'ORBIGNY 1896: 206; SCHMIDT 1913: 125; SCHMIDT 1922: 68; BALTHASAR 1964: 81; BARAUD 1971: 69; DELLACASA M. 1988: 156.

Type locality: Portugal.
Type depository: Museum für Naturkunde der Humboldt Universität, Berlin.

Description – Length 4.5–5.0 mm. Oblong, moderately convex, shiny, glabrous (Fig. 83). Blackish, elytra dark brownish; clypeal margin brown-reddish; legs brown-reddish with tarsi paler; antennal club testaceous. Head with epistoma strongly gibbous, finely, rather densely and subregularly punctured on disc; punctation somewhat larger and irregular laterally, subrugose in front of distinct anterior transverse carina. Clypeus widely sinuate at middle, obtusely rounded at sides, thinly

bordered, border feebly upturned anteriorly; genae angulose, shortly ciliate, distinctly protruding more than eyes; frontal suture finely impressed, somewhat gibbous at middle; frons finely, distinctly and subregularly punctured; epipharynx: Fig. 57; apex of corypha: Fig. 58. Pronotum transverse, moderately convex, doubly punctured; large punctures sparser on disc, somewhat denser on sides, fine punctures subregularly sparse throughout; anterior margin finely bordered; sides almost rounded, thinly bordered; hind angles obtusely rounded; base faintly bisinuate, rather thinly bordered. Scutellum regularly triangular, somewhat sunken, basally almost imperceptibly punctured. Elytra moderately convex, slightly broadened posteriorly; epipleural carina almost faint at shoulder; striae rather deep, superficially punctured, faintly crenulate; interstices flat on disc, slightly convex on preapical declivity, almost imperceptibly punctured. Hind tibiae with superior apical spur longer than first tarsal segment; latter somewhat shorter than following three combined. Male: pronotum relatively more transverse, with large punctures sparser on disc; middle tibiae with inferior apical spur very short, stout, obliquely truncate apically; metasternal plate deeply excavate; aedeagus: Figs 59–60. Female: pronotum relatively less transverse, with large punctures denser on disc; middle tibiae with inferior apical spur regularly elongate and acuminate apically; metasternal plate slightly concave.

Distribution: Portugal, Spain, Morocco?, Algeria?

Ammoecius meurguesae CLÉMENT, 1975 (Figs 33–36, 68)

Ammoecius meurguesae CLÉMENT, 1975*a*: 10; CLÉMENT 1975*b*: 26.
Aphodius (Ammoecius) hyrcanius PETROVITZ, 1980: 607; BARAUD 1981: 136 (as synonym of *meurguesae*); DELLACASA M. 1988: 339.
Aphodius (Ammoecius) meurguesae: BARAUD 1981: 136; DELLACASA M. 1988: 221.

Type locality: Karaj, Mazandaran, Iran.
Type depository: Muséum national d'Histoire naturelle, Paris.

Description – Length 5.5–6.5 mm. Oblong, strongly convex, very shiny, glabrous (Fig. 68). Black; clypeal margin brown-reddish; legs brownish with tarsi paler; antennal club testaceous. Head with cupuliform epistoma finely and regularly punctured on disc; punctation slightly coarser laterally and distinctly granulate in front of rather wide anterior transverse carina; clypeus subangulately sinuate at middle, obtusely angulate at sides, thickly bordered, border upturned; genae obtuse, elongately ciliate, distinctly protruding more than eyes; frontal suture almost faint at middle, finely impressed laterally; frons distinctly and sparsely punctured; epipharynx: Fig. 33; apex of corypha: Fig. 34. Pronotum moderately transverse, strongly convex, somewhat explanate near anterior angles, doubly punctured with large punctures sparse throughout and slightly denser on sides, mixed fine, almost imperceptible punctures subregularly scattered; sides feebly rounded, thickly bordered; hind angles obtusely rounded; base bisinuate, thickly bordered. Scutellum regularly triangular, flat, microreticulate, nearly smooth. Elytra strongly convex, feebly broadened backward; epipleural carina distinctly raised but not denticulate at shoulder; striae almost fine, rather superficially punctured, subcrenulate; interstices flat with extremely fine sparse punctures. Hind tibiae with superior apical spur slightly longer than first tarsal segment; latter as long as following three combined. Male: pronotum relatively more transverse, less convex and with large punctures sparser on disc; fore tibiae with apical spur plump, cylindrical, apically wide and spatulate; inferior apical spur of middle tibiae

very short, obliquely truncate and faintly inwardly hooked at apex; metasternal plate deeply excavate; aedeagus: Figs. 35–36. Female: pronotum relatively less transverse, more convex and with large punctures denser on disc; fore tibiae with apical spur rather short, stout, feebly outwardly curved, obtusely rounded at apex; middle tibiae with inferior apical spur rather short but regularly acuminate at apex; metasternal plate flat.

Distribution: Azerbaijan, Iran.

Remarks – A study of the type material of *Aphodius (Ammoecius) hyrcanius* PETROVITZ, 1980 (MHNG) allows us to confirm its synonymy under *Ammoecius meurguesae* CLÉMENT, 1975.

Ammoecius mimus (PÉRINGUEY, 1901), **comb. n.** (Figs 98, 100–102)

Aphodius (Ammoecius) mimus PÉRINGUEY, 1901: 409; SCHMIDT 1922: 71; PETROVITZ 1964: 188; ENDRŐDI 1978: 179; ENDRŐDI & RAKOVIČ 1981: 42; DELLACASA M. 1988: 162.
Aphodius (Ammoecius) kochi PETROVITZ, 1961: 348; DELLACASA M. 1988: 149, **syn. n.**
Aphodius (Ammoecius) dukei ENDRŐDI, 1964: 105; DELLACASA M. 1988: 231, **syn. n.**

Type locality restricted: Hope Town. [Cape Town, South Africa.]
Type depository: South African Museum, Cape Town.

Description – Length 4.0–5.0 mm. Oblong, strongly convex, shiny, glabrous (Fig. 98). Piceous, clypeal margin, sides of pronotum and elytra more or less widely reddish; legs brown-reddish; antennal club dark testaceous. Head with cupuliform epistoma coarsely, densely and regularly punctured to the pliciform, rather elongate and slightly raised anterior carina in front of which punctation rather dense, coarse and somewhat irregular subrugose; clypeus distinctly sinuate at middle, widely rounded at sides, latter nearly straight, rather thickly bordered, border upturned; genae obtuse, elongately ciliate, distinctly protruding more than eyes; frontal suture deeply impressed; frons slightly depressed at middle, rather sparsely punctured; epipharynx: Fig. 100. Pronotum transverse, convex, simply, regularly and almost coarsely punctured, punctation somewhat denser on sides; latter distinctly bordered, feebly incurvate, maximum width near base; hind angles subtruncate, truncation feebly sinuate; base not bisinuate, distinctly bordered. Scutellum regularly triangular, at base as wide as first two elytral interstices, feebly convex and sparsely punctured on basal half. Elytra elongate, feebly broadened backward, almost imperceptibly denticulate at shoulder; striae fine, faintly crenulate on disc, progressively wider, faintly punctured and not crenulate at all toward apex; interstices feebly convex on disc, more convex on preapical declivity, finely and sparsely punctured. Hind tibiae with superior apical spur as long as first two tarsal segments; first segment distinctly shorter than following three combined. Male: inferior apical spur of middle tibiae shortened, abruptly inwardly curved apically; aedeagus: Figs 101–102. Female: inferior apical spur of middle tibiae elongate and regularly acuminate toward apex.

Distribution: South Africa (Cape Province)

Remarks – In the original diagnosis, PÉRINGUEY (1901: 409) noted: "clypeus [...] with the sides of emargination angular" and later "elytra [...] with the intervals a little costate in the anterior part, but much more distinctly so from the middle to the apex, where they are carinate and impunctate". These characters cannot be verified by the syntypes preserved in the South African Museum.

SCHMIDT (1922: 71) apparently did not see this taxon and dealt with it on the basis of the original description only. PETROVITZ (1961) described *A. kochi* and ENDRŐDI (1964) *A. dukei* but they did not give any distinguishing character from the other Afrotropical *Ammoecius*.

Later, PETROVITZ (1964: 188) stated that *A. mimus* is insufficiently described, though in his key he distinguished *A. dukei, A. mimus,* and *A. kochi* on the basis of morphological characters mentioned in their original descriptions. ENDRŐDI and RAKOVIČ (1981: 31) dealt with these taxa in the same manner, stating that they had difficulties in tracing the type material.

A study of a paratype of *A. kochi* PETROVITZ preserved in the Geneva Museum, as well as a paratype of *A. dukei* ENDRŐDI preserved in the Hungarian Natural History Museum (Budapest), allowed P. BORDAT to determine that these taxa are identical. In addition, the study of six syntypes of *Ammoecius mimus* from "Hope Town" (one "brochette" of 2×3 specimens) bearing a handwritten label by PÉRINGUEY: "*Aphodius mimus* Typ. PY", allows us to state that *A. mimus, A. dukei* and *A. kochi* represent the same taxon because no distinguishing characters exist in the specimens. Finally, examination of a specimen identified as *Aphodius mimus* PÉRINGUEY, labelled "Colonie du Cap, Steynsburg, R. Ellenberg 1915; compared with type by B.-O. Landin", preserved in the Paris Museum, confirmed the correct interpretation of PÉRINGUEY's species by this author.

Ammoecius muchei (PETROVITZ, 1962), **comb. n.**
(Figs 41–44, 49)

Aphodius (Ammoecius) muchei PETROVITZ, 1962: 110; BARAUD 1971: 67; DELLACASA M. 1988: 165.

Type locality: "Ilgas dağ, Umgebung der Passstrasse, Anatolien" [Turkey].
Type depository: Muséum d'Histoire naturelle, Geneva.

Description – Length 6.0–6.5 mm. Oblong, strongly convex, shiny, glabrous (Fig. 49). Black; clypeal margin brown-reddish; legs dark brownish with tarsi paler; antennal club yellowish. Head with cupuliform epistoma microreticulate, finely and rather sparsely punctured on disc; punctation laterally coarser with a few large punctures mixed and irregularly granulate in front of short and sharply raised anterior transverse carina; clypeus angulately sinuate at middle, denticulate at sides, thickly bordered, border distinctly upturned; genae obtusely rounded, elongately ciliate, protruding

more than eyes; frontal suture finely impressed; frons finely and sparsely punctured; epipharynx: Fig. 41; apex of corypha: Fig. 42. Pronotum transverse, strongly convex, doubly punctured; large punctures somewhat sparser on disc, much denser on sides and toward base, mixed punctures extremely fine and subregularly scattered; sides subparallel, thickly bordered; hind angles obtusely rounded; base bisinuate, thickly bordered. Scutellum triangularly elongate, slightly sunken, feebly convex, sparsely and very finely punctured. Elytra strongly convex, feebly broadened posteriorly; epipleural carina distinctly raised but not denticulate at shoulder; striae deep, almost fine, on disc superficially punctured and subcrenulate, laterally coarsely punctured and distinctly crenulate; interstices flat on disc, feebly convex on preapical declivity, almost imperceptibly punctured. Hind tibiae with superior apical spur somewhat longer than first tarsal segment; latter slightly longer than following three combined. Male: pronotum relatively more transverse, less convex and with large punctures more sparse on disc; fore tibiae with apical spur plump, cylindrical, faintly inwardly hooked at apex; inferior apical spur of middle tibiae with short and obliquely truncate at apex; metasternal plate feebly excavate; aedeagus: Figs 43–44. Female: pronotum relatively less transverse, more convex and with large punctures denser on disc; fore tibiae apical spur outwardly curved and apically acuminate; metasternal plate flat.

Distribution: More or less widespread in central Turkey; Greece?.

Remarks – We studied a male specimen from Greece (Alexandropolis), preserved in PIEROTTI's collection at the Genoa Museum, but the collecting record needs to be confirmed.

Ammoecius naviauxi (BARAUD, 1971) **comb. n.**
(Figs 22, 37–40)

Aphodius (Ammoecius) naviauxi BARAUD, 1971: 66; DELLACASA M. 1988: 116.

Type locality: Slennfé, Syrie. [Syria.]
Type depository: BARAUD collection, Muséum national d'Histoire naturelle, Paris.
Type material: Holotype, male: Slennfé, Syrie, 07.05.1970, Naviaux R. leg.

Description – Length 5.5 mm. Short, oval, strongly convex, shiny, glabrous (Fig. 22). Black; clypeal margin and legs piceous; antennal club testaceous. Head with cupuliform epistoma densely, irregularly and subrugosely punctured to the almost narrow and nearly straight anterior carina in front of which the subrugose punctation somewhat finer and superficial; clypeus widely sinuate at middle, distinctly denticulate at sides, laterally rather thinly bordered, border faintly upturned; genae obtusely rounded, sparsely ciliate, distinctly protruding more than eyes; frontal suture fine, slightly raised; frons almost coarsely and regularly punctured; epipharynx: Fig. 37; apex of corypha: Fig. 38. Pronotum strongly transverse, somewhat larger than elytral base, doubly punctured, fine punctures subregularly scattered throughout, mixed larger punctures very sparse on disc toward base, much denser on sides; latter subparallel, thinly bordered; anterior angles distinct, thickly bordered; hind angles widely rounded; base feebly bisinuate, distinctly bordered, border faintly sunk. Scutellum very small, regularly triangular, feebly convex, smooth. Elytra short, oval, broadened posteriorly, distinctly denticulate at shoulder and with strong epipleural carina; striae deep, rather fine, feebly

crenulate with punctures moderately impressed, more coarsely punctured and distinctly crenulate laterally and on preapical declivity; interstices moderately convex on disc, more strongly convex laterally and preapically, sparsely and almost imperceptibly punctured. Hind tibiae with superior apical spur as long as first tarsal segment; latter as long as following three combined. Male: fore tibiae with apical spur stout, downward bent, regularly acuminate toward apex; inferior apical spur of middle tibiae shortened, obliquely truncate and somewhat inwardly hooked apically; aedeagus: Figs 39–40. Female: unknown.

Distribution: Known only from the type locality.

Ammoecius numidicus MULSANT, 1851 (Figs 65, 89–92)

Ammoecius numidicus MULSANT, 1851: 52; BARAUD 1971: 75; DELLACASA M. 1988: 170.

Type locality: "Mahouna, Algérie". [Algeria.]

Type depository: Muséum national d'Histoire naturalle, Paris.

Type material: *Ammoecius numidicus* MULSANT, 1851: **neotype** (male, MNHNP), herewith designated, bearing the following labels: 1) white, handwritten: Algerie/ S. Doguet; 2) white, handwritten: Mahouna/ 26.X.1970; 3) red, handwritten: *Ammoecius/ numidicus* MULSANT, 1851/ Neotypus ♂/ G. Dellacasa & Al., des. 2002.

Description – Length 4.5–5.0 mm. Rather short, oblong, strongly convex, shiny, glabrous (Fig. 65). Black, clypeal margin faintly reddish; legs dark brownish; antennal club testaceous. Head with cupuliform epistoma finely regularly and almost densely punctured to the sharply raised anterior transverse carina in front of which the punctation is finely granulo-rugose; clypeus deeply sinuate at middle, subdenticulate at sides, latter distinctly bordered and regularly arcuate to genae; latter obtusely rounded, elongately ciliate, feebly protruding more than eyes; frontal suture very finely impressed; frons rather densely, finely and regularly punctured; epipharynx: Fig. 89; apex of corypha: Fig. 90. Pronotum transverse; strongly convex, doubly punctured; larger punctures irregularly scattered on the basal two thirds of disc, denser on sides; smaller ones regularly and not very densely throughout sparse; anterior margin finely bordered; hind angles subtruncate; base not bisinuate, rather thickly bordered. Scutellum regularly triangular, flat, with a few fine punctures on basal half. Elytra short, oval, strongly convex, not denticulate at shoulder; striae rather fine, superficially punctured, very feebly crenulate; interstices faintly convex, imperceptibly punctured. Hind tibiae with superior apical spur distinctly longer than first tarsal segment; latter as long as following three combined. Male: inferior apical spur of middle tibiae shortened, apically truncate and inwardly abruptly bent; metasternal plate concave; aedeagus: Figs 91–92. Female: inferior apical spur of middle tibiae elongate and regularly acuminate toward apex; metasternal plate nearly flat.

Distribution: Algeria, Tunisia, Sicily?

Remarks – In the OBERTHÜR's collection at the Paris Museum two specimens (male and female) labelled "Sicilia" are preserved but we did not study any other specimen collected there.

Ammoecius rugifrons AUBÉ, 1850 (Figs 53–56, 84)

Ammoecius rugifrons AUBÉ, 1850: 335; HAROLD, 1871: 10.
Ammoecius levaillanti GODART, 1852: 297; REICHE 1852: LIX (as synonym of *rugifrons*).
Aphodius (Ammoecius) rugifrons: REITTER 1892: 184; d'ORBIGNY 1896: 206; SCHMIDT 1913: 125; SCHMIDT 1922: 70; BALTHASAR 1964: 80; BARAUD 1971: 69; DELLACASA M. 1988: 192.

Type locality: "Algérie". [Algeria.]
Type depository: Muséum national d'Histoire naturelle, Paris.

Description – Length 4.0–5.0 mm. Short, feebly oval, strongly convex, shiny, glabrous (Fig. 84). Black; clypeal margin brown-reddish; legs brown-reddish with tarsi paler; antennal club testaceous. Head with strongly convex epistoma coarsely and subrugosely punctured; punctation distinctly granulose in front of the short and moderately raised anterior carina; clypeus angulately sinuate at middle, obtusely rounded at sides, thickly bordered, border distinctly upturned; genae obtusely rounded, rather shortly ciliate, protruding more than eyes; frontal suture finely impressed, faintly gibbous at middle; frons coarsely and subregularly punctured; epipharynx: Fig. 53; apex of corypha: Fig. 54. Pronotum subquadrate, strongly convex, doubly punctured; large punctures sparse on disc but much denser on sides, mixed distinct fine punctures regularly scattered; anterior margin very finely bordered; sides feebly rounded, thinly bordered; hind angles widely rounded; base distinctly bisinuate, thickly bordered. Scutellum regularly triangular, coarsely and rather densely punctured. Elytra strongly convex, somewhat broadened backwardly; epipleural carina distinct but not denticulate at shoulder; striae large and deep, rather superficially punctured, subcrenulate; interstices feebly convex on disc, more convex on preapical declivity, finely, sparsely punctured. Hind tibiae with superior apical spur longer than first tarsal segment; latter nearly as long as following three combined. Male: epistoma relatively more distinctly and less coarsely punctured; pronotal disc with large punctures more sparse; middle tibiae with inferior apical spur short, stout and obliquely truncate apically; metasternal plate deeply excavate; aedeagus: Figs 55–56. Female: epistoma relatively more irregularly and more coarsely punctured; pronotal disc with large punctures rather dense; middle tibiae with inferior apical spur elongate and regularly acuminate apically; metasternal plate flat.

Distribution: Italy (western Sardinia, Sicily?), Tunisia, Algeria.

Remarks – In LUIGIONI's catalogue (1929: 373), this species is cited from Sicily (Etna) but we did not study any specimen collected there.

Ammoecius satanas (CARPANETO, 1976), **comb. n.** (Figs 29–32, 50)

Aphodius (Ammoecius) satanas CARPANETO, 1976: 243; DELLACASA M. 1988: 194.

Type locality: Çamlik env., south Belşehir Lake, m. 1200, Vil. Konya. [Turkey.]
Type depository: Università di Roma "La Sapienza", Rome.

Material examined: Vil. Antalya, 40 km S Akseki, 3 km S Fersin, 650 m, 06.05.1989, Pittino L. & R. leg. (1 male, PCM); Sertavul Geç., Südseite, ca. 1400 m (Waldzone), 22.04.1981, Anatolia mer., Heinz leg. (1 female, DCG).

Description – Length 6.5–7.5 mm. Oblong, strongly convex, very shiny, glabrous (Fig. 50). Blackish, clypeal margin and anterior angles of pronotum faintly reddish; legs brownish; antennal club dark testaceous. Head with epistoma doubly irregularly punctured on disc, few large punctures sparse laterally, mixed extremely fine ones becoming imperceptible at center; punctation in front of anterior strong and wide carina simple, regular, somewhat denser and relatively more distinct; clypeus broadly sinuate at middle, strongly denticulate at sides, rather thickly bordered, border upturned; genae obtusely rounded, rather elongately ciliate, protruding more than eyes; frontal suture obsolete at middle, almost faint laterally; frons finely punctured on sides only; epipharynx: Fig. 29; apex of corypha: Fig. 30. Pronotum moderately transverse, strongly convex, doubly punctured; large punctures irregularly sparse, somewhat denser on sides, very fine ones mixed and regularly scattered throughout; anterior margin with vestiges of border to level of eyes; sides feebly rounded, thinly bordered, border shortly bristled toward front angles; hind angles obtusely rounded; base faintly bisinuate, rather thinly bordered. Scutellum feebly convex, with curved sides, with trace of lateral border; basally finely punctured. Elytra oblong elongate, subdenticulate at shoulder; striae rather deeply impressed, coarsely punctured, strongly crenulate; interstices nearly flat on disc, feebly convex laterally, imperceptibly punctured. Hind tibiae with superior apical spur longer than first tarsal segment; latter nearly as long as following three combined. Male: fore tibiae with apical spur spatulate and feebly broadened apically at each side; inferior apical spur of middle tibiae very short and obliquely truncate apically; metasternal plate concave; aedeagus: Figs 31–32. Female: fore tibiae with apical spur, as well as inferior apical spur of middle tibiae, regularly acuminate toward apex; metasternal plate nearly flat.

Distribution: Southern Turkey.

Ammoecius terminatus HAROLD, 1869 (Figs 97, 106–108)

Ammoecius terminatus HAROLD, 1869: 100; HAROLD 1871: 18 (as synonym of *lugubris*).
Aphodius (Ammoecius) terminatus: SCHMIDT 1922: 69 (as synonym of *lugubris*); ENDRŐDI & RAKOVIČ 1981: 42 (as synonym of *lugubris*); DELLACASA M. 1988: 207 (as synonym of *lugubris*).
Aphodius (Ammoecius) orycis ENDRŐDI, 1980: 34; DELLACASA M. 1988: 339, **syn. n.**
Aphodius (Ammoecius) orycoides ENDRŐDI, 1980: 34; DELLACASA M. 1988: 339, **syn. n.**

Type locality: Cap. [Cape Town, South Africa.]

Type depository: Muséum national d'Histoire naturelle, Paris.

Type material: *Ammoecius terminatus* HAROLD, 1869: **lectotype**, (female, MNHNP), herewith designated, bearing the following labels: 1) white, handwritten: Cap. *A. viduus* Dej; 2) white, handwritten by Harold: *terminatus* Typ. Hrld; 3) white, printed: Ex Musaeo E. Harold; 4) red, printed: TYPE; 5) red, handwritten: *Ammoecius terminatus* HAROLD, 1869, Lectotype ♀, P. Bordat des. 2001.

Aphodius (Ammoecius) orycis ENDRŐDI, 1980: holotype (male, TMP): S. Afr. Namaq Coast, Gemsbok vlakte.

Aphodius (Ammoecius) orycoides ENDRŐDI, 1980: holotype (female, TMP): S. Afr. Namaq Coast, Gemsbok vlakte.

Description – Length 3.5–5.5 mm. Oblong, convex, shiny, glabrous (Fig. 97). Piceous-black; clypeal margin, sides of pronotum and elytra more or less widely brown-reddish; legs dark brownish; antennal club dark testaceous. Head with cupuliform epistoma coarsely and regularly punctured to the arcuate, rather elongate and distinctly raised anterior carina in front of which the punctation is rather fine and sparse; clypeus widely sinuate at middle, subdenticulate and upturned at sides, latter feebly curved and thinly bordered; genae obtusely rounded, elongately ciliate, feebly protruding more than eyes; frontal suture distinctly impressed; frons coarsely and regularly punctured, faintly depressed at middle; epipharynx Fig. 106. Pronotum transverse, strongly convex, simply, regularly and almost coarsely punctured, punctation somewhat denser on sides; latter moderately arcuate, distinctly bordered, maximum width near base; hind angles subtruncate; base faintly bisinuate, rather thickly bordered. Scutellum regularly triangular, at base as wide as two first elytral interstices, sparsely punctured on basal half. Elytra rather elongate, moderately widened backward, almost imperceptibly denticulate at shoulder; striae fine and faintly crenulate on disc, somewhat wider and not crenulate at all toward apex; interstices nearly flat on disc, moderately convex preapically, finely and sparsely punctured. Hind tibiae with superior apical spur longer than first tarsal segment; latter faintly shorter than following three combined. Male: inferior apical spur of middle tibiae shortened, abruptly inwardly curved apically; aedeagus: Figs 107–108. Female: inferior apical spur of middle tibiae elongate and regularly acuminate toward apex.

Distribution: South Africa (Northern and Western Cape Province, Namaqualand).

Remarks – HAROLD (1869: 100) described *Ammoecius terminatus* comparing it with *A. lugubris* BOHEMAN, but later (1871: 18) he considered them synonyms. Subsequent authors did not verify this synonymy, and accepted HAROLD's decision. Based on a study of the types, P. BORDAT determined that they are two different species.

In 1980, ENDRŐDI described *Aphodius (Ammoecius) orycis* and *Aphodius (Ammoecius) orycoides* comparing them with *Aphodius (Ammoecius?) brevitarsis* PÉRINGUEY. The examination of the type material showed that distinguishing characters mentioned by ENDRŐDI (e.g. shape of elytral striae) for separating *A. orycis* from *A. orycoides* are inadequate, resulting in the decision that they are junior synonyms of *Ammoecius terminatus*. On the other hand, BORDAT (1990: 135) moved *Aphodius brevitarsis* from *Ammoecius* to *Australaphodius* based on its morpho-anatomical characteristics.

CATALOGUE

Ahermodontus BÁGUENA, 1930

Type species: *Ahermodontus marini* BÁGUENA, 1930 (monotypy)

ambrosi (PARDO ALCAIDE, 1936) – Spain, Morocco

bischoffi (VŠETEČKA, 1939) – Albania

marini BÁGUENA, 1930 – Spain

Ammoecius MULSANT, 1842

Type species: *Scarabaeus elevatus* OLIVIER, 1789 (monotypy)

amplicollis (PEYERIMHOFF, 1939) – Morroco (Haut Atlas)

brevis ERICHSON, 1848 – Europe: northwards up to Sweden, in south from Spain to Georgia (missing from southern Italy, Sardinia, Sicily, Greece and European Turkey); Asia: Turkmenistan, Mongolia, Siberia (missing from Asia Minor)

dentatus SCHMIDT, 1908 – Portugal (Algarve), Spain (Andalusia), Morocco

dogueti (BARAUD, 1980) – Algeria

elevatus (OLIVIER, 1789) – soutwestern Europe (Portugal, Spain, southern France, northwestern Italy: western Liguria); Mediterranean Africa (Morocco, Algeria, Tunisia, Libya)

= *chobauti* (BÁGUENA, 1927)

= *corellai* (BALTHASAR, 1941)

= *persimilis* (SCHATZMAYR, 1946)

= m. *edentulus* MULSANT, 1842

= ab. *fusciventris* MULSANT, 1842

eli (PETROVITZ, 1961) [doubtful species] – Iraq

felscheanus REITTER, 1904 – Algeria, Morocco(?)

franzi (PETROVITZ, 1964) – Morocco (Haut Atlas, Moyen Atlas)

frigidus BRISOUT, 1866 – Portugal, Spain, Morocco(?)

= ab. *galaicus* (BÁGUENA, 1955)

incultus (PETROVITZ, 1961) – South Africa (Cape Province)

lugubris BOHEMAN, 1857 – South Africa (Cape Province)

= *bidentulus* HAROLD, 1871

= *dentinus* (PÉRINGUEY, 1901)

lusitanicus ERICHSON, 1848 – Portugal, Spain, Morocco(?), Algeria(?)

meurguesae CLÉMENT, 1975 – Azerbaijan, Iran

= *hyrcanius* (PETROVITZ, 1980)

mimus (PÉRINGUEY, 1901) – South Africa (Cape Province)

= *dukei* (ENDRŐDI, 1964)

= *kochi* (PETROVITZ, 1961)

muchei (PETROVITZ, 1962) – central Turkey, Greece(?)

naviauxi (BARAUD, 1971) – Syria

numidicus MULSANT, 1851 – Algeria, Morocco, Tunisia, Sicily(?)

rugifrons AUBÉ, 1850 – Algeria, Tunisia, Italy (western Sardinia, Sicily?)

= *levaillanti* GODART, 1852

satanas (CARPANETO, 1976) – Turkey

terminatus HAROLD, 1869 – South Africa (Northern and Western Cape Province, Namaqualand)

= *orycis* ENDRŐDI, 1980

= *orycoides* ENDRŐDI, 1980

= *viduus* (Dejean, 1833) [*nomen nudum*]

Vladimirellus M. DELLACASA, G. DELLACASA et BORDAT, 2003
Type species: *Aphodius socors* BALTHASAR, 1967 (herewith designated)
socors (BALTHASAR, 1967) – Siberia

*

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VIETTAGONA VIETNAMENSIS GEN. ET SP. N. FROM VIETNAM (COLEOPTERA, TENEBRIONIDAE: BLAPTINI)

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Viettagona vietnamensis gen. et sp. n. is described from the Lao Cai Province, Vietnam. A key to the subtribes and genera of the tribe Blaptini is given.

Key words: taxonomy, Coleoptera, Tenebrionidae, Blaptini, new species, new genus, Vietnam, identification key

INTRODUCTION

The southern border of the range of tribe Blaptini roughly coincides with the southern limit of the Palaearctic Region. Only a few species of the tribe penetrate into tropical areas of Asia and Africa. L. PEREGOVITS and T. VÁSÁRHELYI (Hungarian Natural History Museum, Budapest) have discovered a new species of Blaptini in North Vietnam. This species, for which a new genus is erected, inhabits high mountains (2540 m). The beetles were found to be active at night, as in the case of their Palaearctic relatives. The genus *Viettagona* gen. n. is closely related to *Asidoblaps* FAIRMAIRE, 1886 occurring in the mountains of the eastern part of the Tibetan Plateau (Sichuan, Yunnan) and in Taiwan.

The following acronyms are used for indicating depositories of the specimens: HNHM – Hungarian Natural History Museum, Budapest, Hungary; ZIN – Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.

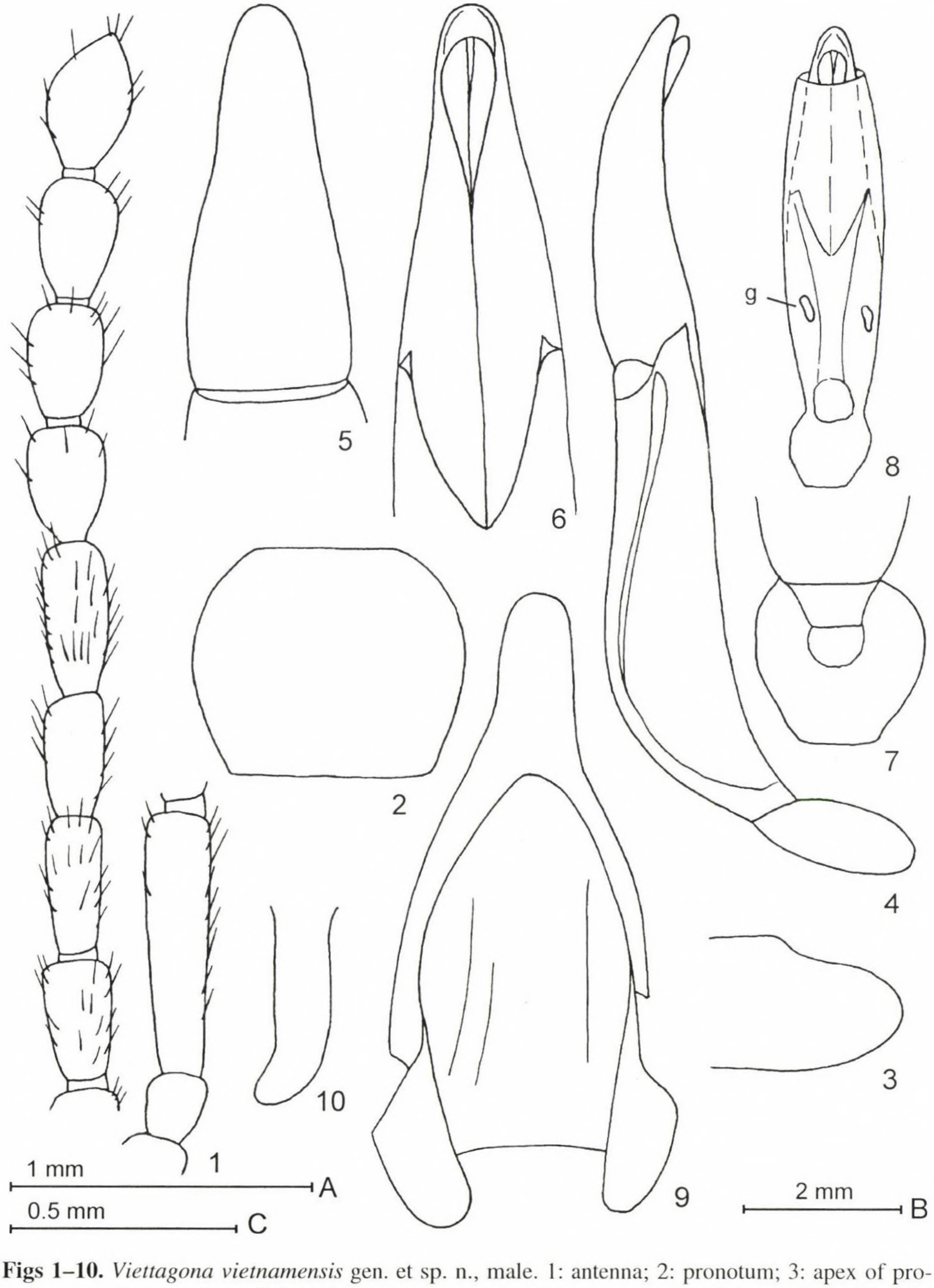
Viettagona gen. n.

Type species – Viettagona vietnamensis sp. n.

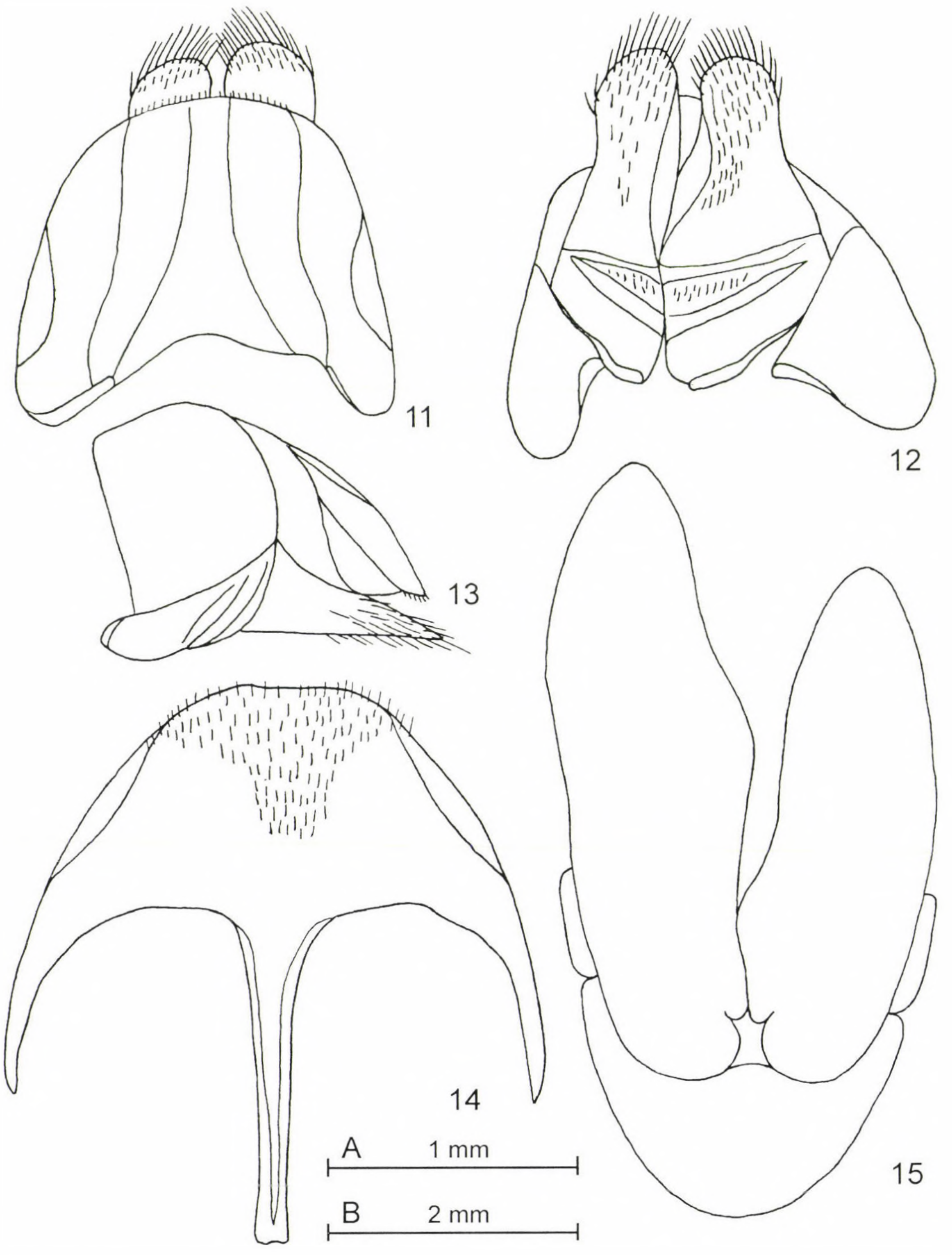
Description – Anterior margin of clypeus straight. Antennae (Fig. 1) of male with two terminal segments extending beyond base of pronotum if directed backwards; antennae of female with apices reaching base of pronotum. Prothorax and elytra rather strongly narrowing toward base. Elytra of female swollen. Epipleural carina smooth at base. Epipleura extending to apex of elytra. Dorsal margin of inner surface of profemur with weak rounded process apically (Fig. 3). Inner surface of all tibiae with light hair brush at apex. Apical spurs on protibia small, slightly differing in length, pointed

apically. Pro- and mesotibiae thickened in apical half. Hair brushes present on plantar surface of protarsomeres 1 and 2 mesotarsomere 1. Other tarsal segments, except for claw segment, with a bunch or groups of pale hairs. Reservoirs of defensive glands large (Fig. 15). Parameres with rounded apical margin; in lateral view, slightly and evenly curved (Fig. 4). Middle suture on dorsal surface of parameres not pronounced. Opening for penis protraction situated at apex of parameres (Fig. 6). Glands of aedeagal bursa very small (Fig. 8). Common shaft of spiculum ventrale wide (Fig. 9). Male abdominal ventrite 8 with short and wide gland (Fig. 10). Apical margin of lobes of ovipositor widely rounded, covered with long setae (Figs 11, 12). Spermathecal duct long and thin, 1st and 2nd reservoirs of spermatheca with common long base (Fig. 16). Base of spermathecal sphincter long.

Remarks – *Viettagona* gen. n. belongs to a group of genera including *Tagonoides* FAIRMAIRE, 1886, *Gnaptorina* REITTER, 1887, *Montagona* G. MEDVEDEV, 1998, *Itagonia* REITTER, 1887, *Sintagona* G. MEDVEDEV, 1998, *Agnaptoria* REITTER, 1887, *Asidoblaps* FAIRMAIRE, 1886, *Blaptogonia* G. MEDVEDEV, 1998, *Nepalindia* G. MEDVEDEV, 1998 and *Colasia* KOCH, 1965 (see MEDVEDEV 1998*a, b,* 2001*a*). Based on ovipositor structure, three subgroups are distinguished: 1) *Montagona, Tagonoides*, *Itagonia*, *Gnaptorina* (ovipositorial lobes cuneate, narrowed apically – Fig. 17); 2) *Agnaptoria*, *Asidoblaps*, *Nepalindia* and probably also *Sintagona*, female of which is not known (apical margin of ovipositorial lobes obliquely truncate – Fig. 18); 3) *Colasia* (ovipositorial lobes rounded apically – Fig. 19). *Viettagona* is similar in the structure of the ovipositorial lobes to the genus *Colasia*, differing from it in the shorter and wider parameres (Fig. 20) and distribution. In addition, *Colasia akisoides* KOCH, 1965 differs from *Viettagona* in the absence of pale hair brushes on plantar surface of male pro- and mesotarsomeres, and in the bases of spermathecal reservoirs being separated from each other by rather long duct, bases of reservoirs and spermathecal sphincter approximate. A considerable development of pale hairs on plantar surface of tarsi differentiates *Viettagona* from the genera *Nepalindia* and *Blaptogonia*. In the species of the latter genera, pale hair brush is present only on male protarsomere 1. At the same time, the characters of the tarsal structure unite *Viettagona* with *Asidoblaps* and *Agnaptoria*. Presence of a weak rounded process on dorsal margin of inner surface of profemur and the structure of widened in apical half meso- and metatibiae reveal close affinity of *Viettagona* to *Asidoblaps* and *Agnaptoria*. Another support for this point of view is the structure of legs and female genital tubes in the genera *Agnaptoria*, *Asidoblaps* and *Viettagona*. In particular, meso- and metatibiae in *Viettagona* are abruptly widened in apical half, like in *Agnaptoria*; and 1st and 2nd reservoirs of spermatheca in *Viettagona* and *Asidoblaps* (for instance, in *Asidoblaps smetanai* G. MEDVEDEV, 2001 from Taiwan; see Fig. 27 and MEDVEDEV 2001*b*) form a well-developed common base. *Viettagona* differs from these genera in the following characters: apical margin of ovipositorial lobes rounded; inner surface of all tibiae covered with pale setae; parameres evenly curved in lateral



Figs 1–10. *Viettagona vietnamensis* gen. et sp. n., male. 1: antenna; 2: pronotum; 3: apex of profemur; 4: aedeagus in lateral view; 5–6: parameres in dorsal and lateral view; 7: base of basal piece of aedeagus in dorsal view; 8: aedeagus in membranous bursa (*g* – gland); 9: spiculum ventrale; 10: gland of sternite VIII in lateral view. A: scale to Figs 1, 3, 4–7, 9; B, to Fig. 2, C, to Fig. 10



Figs 11–15. *Viettagona vietnamensis* gen. et sp. n., female. 11–13: ovipositor in dorsal, ventral, and lateral view; 14: spiculum ventrale; 15: reservoirs of defensive glands. A: scale to Figs 11–14; B, to Fig. 15

view; common shaft of spiculum ventrale wide. In *Asidoblaps* and *Agnaptoria*, only pro- and mesotibiae are covered with pale setae on inner side; parameres in lateral view S-curved (Fig. 21, 22), common shaft of spiculum ventrale long and thin (Fig. 23).

Viettagona vietnamensis sp. n.
(Figs 1–16, 28–31)

Type material – Holotype, male labelled as follows: "Vietnam, Lao Cai Prov., 6 km W of Cat Cat, 2540 m, 22°17.814' N, 103° 48.657' E, singled at night, No. 13, 14.III.1998, leg. L. Peregovits & T. Vásárhelyi" (HNHM). Paratypes: labelled as holotype, 2 males (HNHM); 1 male, 1 female (ZIN).

Description – Body brownish, weakly shining; head, pronotum, underside, antennae and legs darker, nearly black.

Male (Figs 28–29). Outer margin of head with wide obtuse-angled incision above antennal base. Outer margins of genae arcuately converging from anterior margin of eyes to base of clypeus. Outer margin of temples and eyes roundly protruding from cervical constriction to genae. Dorsal sur-

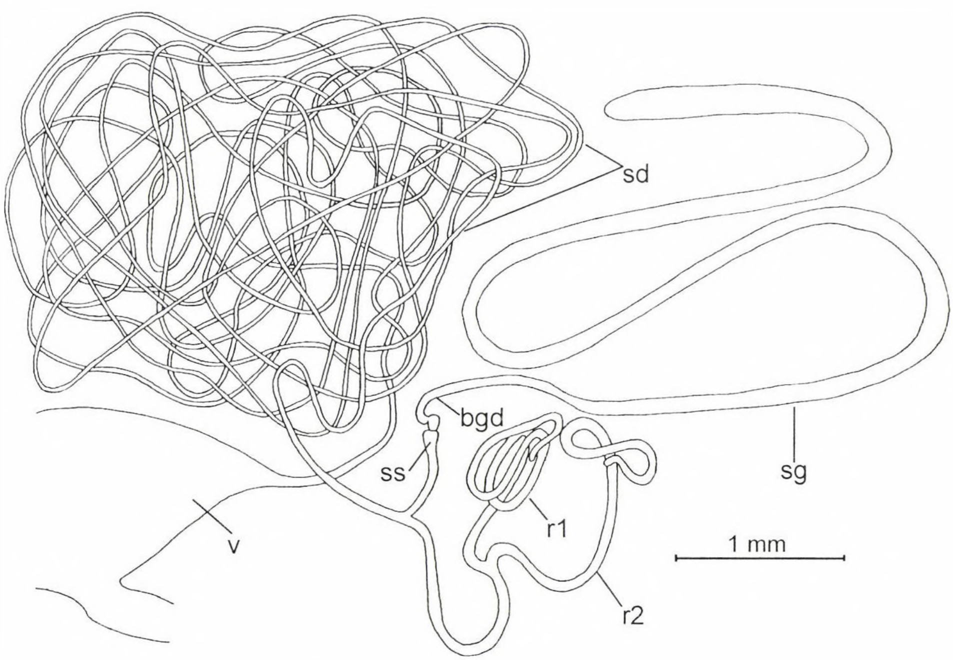
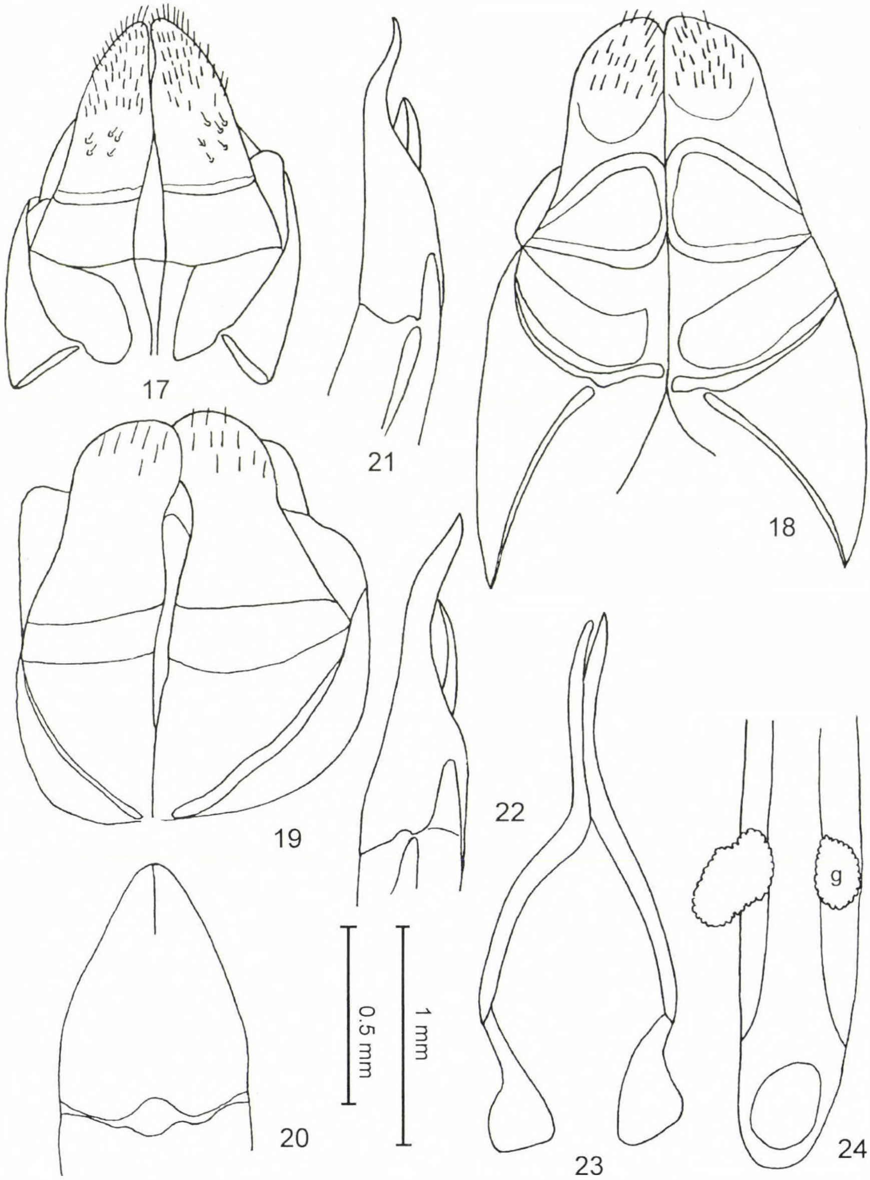


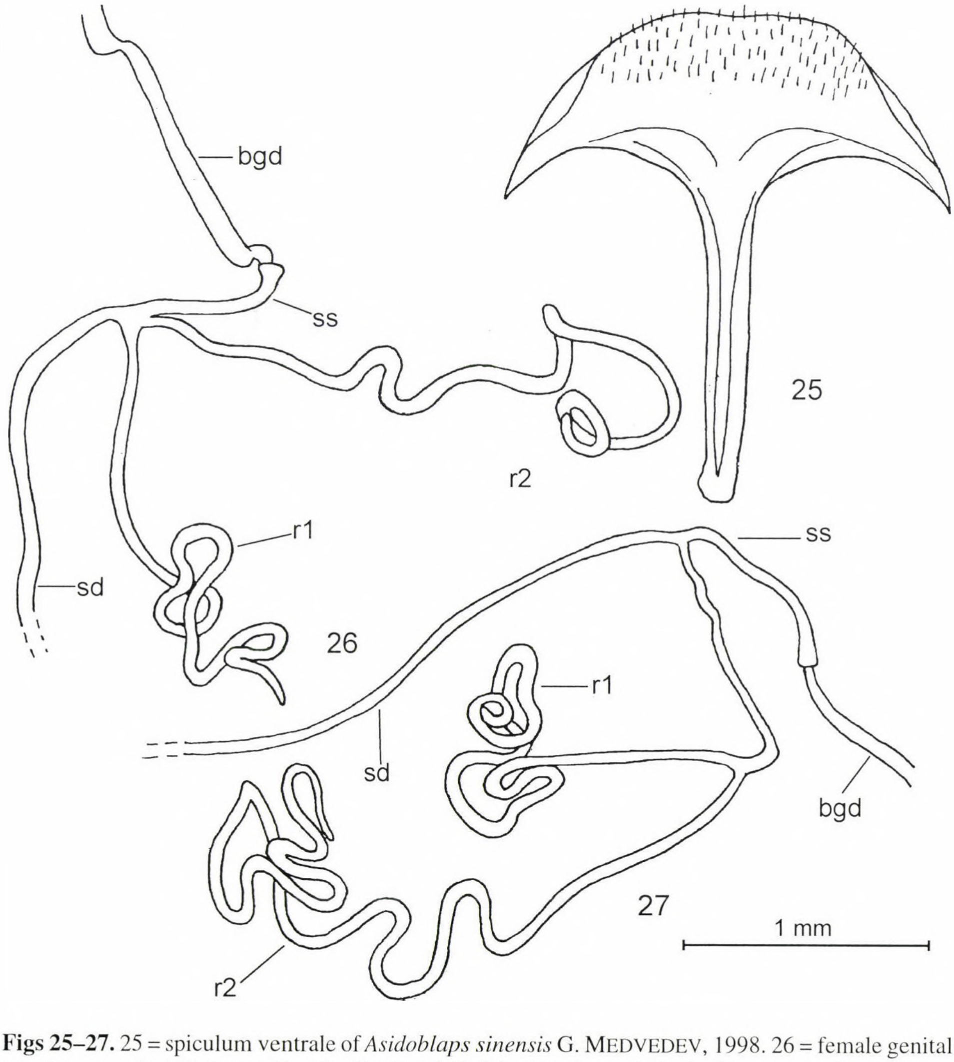
Fig. 16. *Viettagona vietnamensis* gen. et sp. n., female genital tubes. *v*: vagina; *sg*: spermathecal gland; *ss*: spermathecal sphincter; *sd*: spermathecal duct; *r1*: 1st reservoir and *r2*, 2nd reservoirs of spermatheca



Figs 17–24. 17 = *Montagona sculpturata* (Gebien, 1913). 18 = *Nepalindia nepalica* (Kaszab, 1973). 19–20 = *Colasia akisoides* Koch, 1965. 21 = *Asidoblaps potanini* G. Medvedev, 1998. 22 = *A. sinensis* G. Medvedev, 1998. 23–24 = *A. zamotailovi* G. Medvedev, 1998. [17–19 – ovipositor in ventral view; 20 – parameres in dorsal view; 21, 22 – parameres in lateral view; 23 – spiculum ventrale; 24 – basal piece of aedeagus in ventral view (*g* – gland)]. A: scale to Figs 17, 18, 23, 24; B, to Figs 19, 20–22

face of head in anterior half flat, very finely punctate. Basal segments of antennae covered with light setae. Length (width) ratio of antennomeres 2 to 11 is as follows: 11(10) : 46(13) : 20(12) : 22(12) : 22(12) : 22(12) : 20(13) : 20(15) : 25(15) : 27(17). Antennomere 3 4.2 times as long as antennomere 2, and 2.3 times as long as antennomere 4.

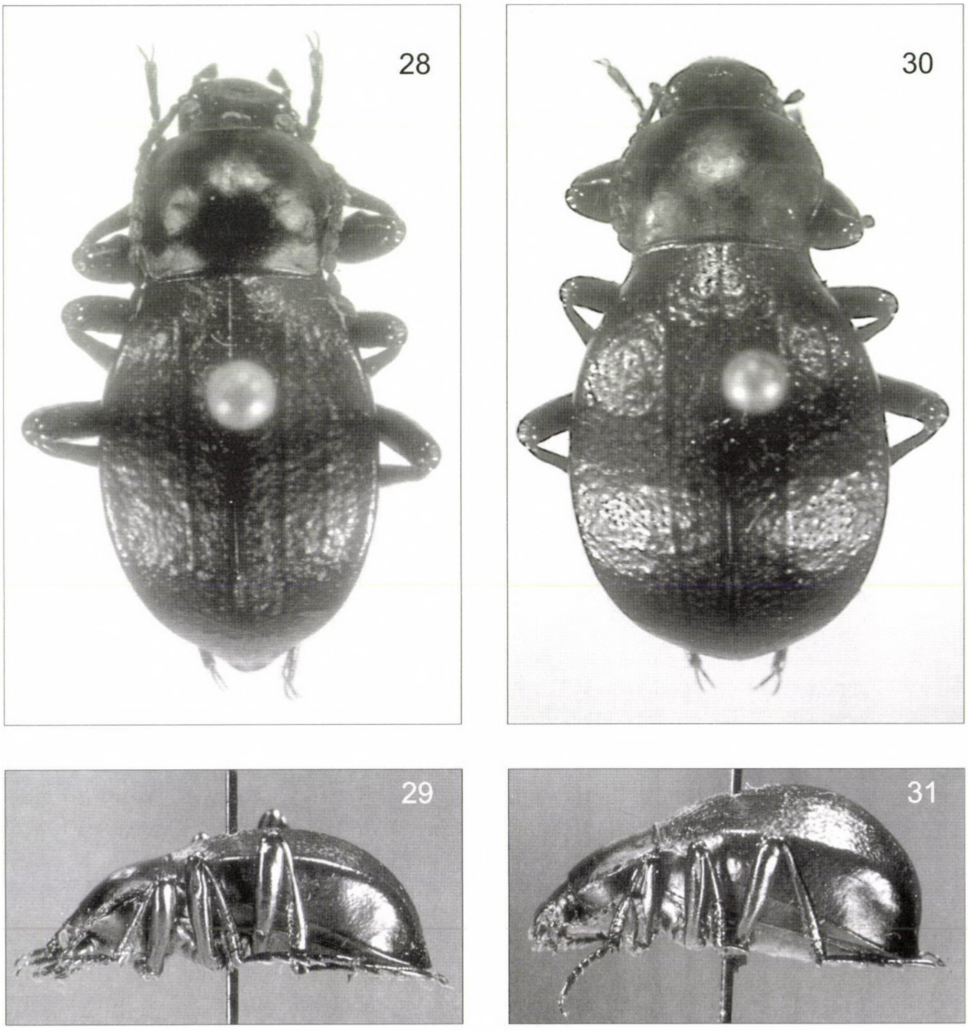
Pronotum (Fig. 2) transverse (1.21–1.24 times as wide as long), widest in the middle, 1.69–1.70 times as wide as head. Ratio of pronotal width at anterior margin to its maximum width and width at base (n = 2) 0.53 : 1.00 : 0.79, on the average. Outer margin of pronotum arcuately protruding in ante-



Figs 25–27. 25 = spiculum ventrale of *Asidoblaps sinensis* G. MEDVEDEV, 1998. 26 = female genital tube (fragment) of *Colasia akisoides* KOCH, 1965. 27 = female genital tube (fragment) of *Asidoblaps smetanai* G. MEDVEDEV, 2001. Abbreviations: *r1* – 1st reservoir and *r2* – 2nd reservoir of spermatheca; *bgd* – basal gland duct; *sd* – spermathecal duct; *ss* – spermathecal sphincter

rior 2/3; in posterior 1/3 tapering to base with almost straight sides; anterior margin rather deeply arcuately emarginate, base straight. Anterior and posterior angles of pronotum obtuse, rounded apically. Pronotal disc evenly convex in anterior 2/3 or slightly flattened along sides, very finely punctate. Prothoracic hypomeron not flattened along outer margin, finely rugose. Intercoxal process of prosternum steeply sloping behind coxae, covered with pale setae.

Elytra elongate (1.59 times as long as wide), as wide as pronotum. Epipleural carina visible in dorsal view at apex only. Apical declivity rather weak. Humeral carina well-pronounced, smooth at base. Elytral surface between humeral carina and sutural margin slightly convex, with one low carina



Figs 28–31. *Viettagona vietnamensis* gen et sp. n.: 28–29 = holotype, male: 28 = dorsal view, 29 = lateral view, 30–31 = paratype, female: 30 = dorsal view, 31 = lateral view. (Photo: I. RETEZÁR)

vanishing on apical declivity and fragments of a second carina. Elytral surface covered with very fine punctation, fine rugosity and flattened pustules. Lateral (reflexed) part of elytra finely punctate. Epipleura smooth. Visible abdominal ventrites finely punctate and covered with light setae. Intercoxal process of visible abdominal ventrite 1 depressed.

Legs long. Length(width) ratio of pro-, meso- and metafemora 98(23) : 108(20) : 128(19); that for corresponding tibiae 80(11) : 90(15) : 125(15).

Aedeagus as in Figs 5–7; length 4.1 mm (when body length 14.3 mm). Length of paramere 1.6, width 0.7 mm.

Female (Figs 30–31). Body wider, elytra more swollen than in male. Humeral carina more obliterated at base. Meso- and metatibiare more distinctly widening in distal half. Antennomeres 8 to 11 shorter than in male, their length(width) ratio 15(15) : 16(16) : 16(16) : 23(16). Apical declivity of elytra steep, elytral apex produced in the form of short flattened prominence. Pronotum 1.22–1.31 times as wide as long, 1.61–1.73 times as wide as head. Elytra 1.46–1.52 times as long as wide, 1.52–1.56 times as wide as pronotum. Ovipositor as in Figs 11–13; spiculum ventrale as in Fig. 14; reservoirs of defensive glands as in Fig. 15.

Female genital tubes (Fig. 16). Spermathecal duct long and thin. Length of spermathecal duct 58 mm, that of spermathecal gland, 77 mm, with body length 15.5 mm. First and second reservoirs of spermatheca forming a well-developed common base, bent in distal part. Base of spermathecal sphincter rather long.

Male body length 14.2–14.3 mm, width 6.6 mm; female length 14.8–15.3 mm, width 7.6–8.1 mm.

KEY TO THE SUBTRIBES AND GENERA OF BLAPTINI

The subsequent text is a translation of the identification key to Blaptini published by MEDVEDEV (2000, 2001*a*: 33–38), with some modification, e. g. inclusion of *Viettagona* gen. n. The many figures published by him are not repeated here. For a successful identification the reader should use both this key and the figures in the above mentioned book.

I (IV) Metatarsomeres and usually also mesotarsomeres compressed laterally, but apical declivity of elytra always without sutural tubercles. If compression not apparent, at least one of the following features can be observed: apical spur of female protibia very large, nearly as wide basally as tibial apex; apex of parameres with deep and sharp incision; basal piece of aedeagus with apical lateral lobes, apical part of ovipositor (coxite) in lateral view forming convex surface at base of apical lobes

II (III) Female protibia with one large spur nearly as wide basally as femoral apex; male protibia with two spurs: one larger but much narrower than protibia and another smaller. Eyes not protruding, not reaching width of temples. Protarsomere 1 simple

subtribe Gnaptorina G. MEDVEDEV, 2001
(type genus: *Gnaptor* BRULLÉ, 1832)

1 (1) Basal piece of aedeagus without apical lobes, apex of parameres with deep and sharp incision. Ventral surface of apical part of ovipositor flattened in lateral view *Gnaptor* BRULLÉ, 1832

III (II) Male and female protibia with two spurs which may strongly differ in length, but base of larger spur considerably narrower than protibia even in female. If protibia with one spur only, eyes very large, strongly protruding. Ventral surface of apical part of ovipositor convex in lateral view subtribe Prosodina SKOPIN, 1960 (type genus: *Prosodes* ESCHSCHOLTZ, 1829)

1(2) Eyes very large, strongly protruding from temple, width measured across eyes 1.3–1.5 as wide as width measured across genae. Male and female protibia with one spur. Female protarsomere 1 often securiform, strongly compressed laterally *Tagona* FISCHER DE WALDHEIM, 1822

2 (1) Eyes normal, not protruding, temples parallel-sided or convergent. Female protarsomere 1 simple. – Male basal protarsomeres often with hair brush on plantar surface *Prosodes* ESCHSCHOLTZ, 1829

IV (I) Meta- and mesotarsomeres not compressed laterally; if compressed (*Remipedella*), apical declivity of elytra with two sutural tubercles. – Apical part of ovipositor angulately or cuneately narrowing in lateral view. Basal piece of aedeagus without apical lateral lobes

V (VI) Apical declivity of elytra with two sutural tubercles. Elytral epipleura smooth, epipleural carina effaced. Antennae short, barely reaching anterior edge of pronotum if directed backwards. Anterior margin of clypeus with brush of yellow hairs. Pro- and mesotibia strongly arcuate, metatibia strongly dilated toward apex, where covered with sharp granules. Meso- and metatarsomeres strongly compressed laterally, plantar surface with long pale hairs subtribe Remipedellina SEMENOV, 1906 (type genus: *Remipedella* SEMENOV, 1906)

1 (1) Body small (7.1–9.6 mm). Antennomeres 7 to 10 transverse. Outer surface of apical half of protibia smooth, shiny *Remipedella* SEMENOV, 1906

VI (V) Apical declivity of elytra without sutural tubercles. Elytral epipleura with sharp carina. Antennae longer, clearly surpassing anterior edge of pronotum if directed backwards

VII (VIII) Antennomere 7 narrower than 8. Apical part of ovipositor short, 1–1.4 times as long as wide. Lobes of ovipositor more or less densely covered with setae. – Elytra not produced apically. Male abdomen without hairy pit on the border between visible ventrites 1 and 2
subtribe Gnaptorinina G. MEDVEDEV, 2001
(type genus: *Gnaptorina* REITTER, 1887)

1 (6) Upper spur of protibia noticeably larger than lower spur; in female, always larger than in male (Fig. 61 in MEDVEDEV 2001*a*)

2 (3) Upper edge of inner surface of profemur with tooth or strong, somewhat angularly arcuate prominence (Fig. 66 in MEDVEDEV 2001*a*). – Upper spur of female protibia very large, lower spur missing. Parameres evenly or shallowly arcuately narrowing to apex, or, sometimes, more abruptly narrowing near apex (Figs 825, 828, 831 in MEDVEDEV 2001*a*) *Itagonia* REITTER, 1877

3 (2) Upper edge of inner surface of profemur straight or, if femur widened in apical part, broadly arcuate

4 (5) Prosternum in front of procoxae vertical or nearly vertical. Female metatibia with inner spur dilated apically, spatulate; upper spur of protibia very large, rounded apically. Parameres abruptly narrowing in apical part, deeply emarginate on outer side (Fig. 857 in MEDVEDEV 2001*a*) *Gnaptorina* REITTER, 1887

5 (4) Prosternum in front of procoxae oblique to the horizontal plane. Female metatibia with inner spur rather narrow, parallel-sided; upper spur of protibia noticeably larger than lower spur, but not particularly enlarged. Parameres evenly narrowing apically (Fig. 818 in MEDVEDEV 2001*a*) *Tagonoides* FAIRMAIRE, 1886

6 (1) Spurs of protibia subequal in length

7 (8) Prosternum in front of procoxae vertical. – Upper edge of inner surface of profemur without tooth or angular prominence. Tibiae usually more strongly dilated in apical part (Figs 69, 70 in Medvedev 2001a); coxae, trochanters, femora and tibiae often red, tarsi dark; basal antennomeres also often red
Agnaptoria REITTER, 1887

8 (7) Prosternum in front of procoxae oblique to the horizontal plane. – Tibiae regularly widening from base to apex, dark

9 (12) In male, inner surface of at least pro- and mesotibiae densely covered with pale hairs in apical part. Dorsal margin of inner surface of profemur sometimes dentate

10 (11) In male, inner apical surface of all tibiae densely covered with pale hairs. Pronotum distinctly cordate, with punctation obsolete *Viettagona* gen. n.

11 (10) In male, inner apical surface of pro- and mesotibiae densely covered with pale hairs. Pronotum not or at most indistinctly cordate, with punctation fine or moderately coarse *Asidoblaps* FAIRMAIRE, 1886

12 (9) In male, all tibiae lacking pale hair brush in apical part of inner surface. – Dorsal margin of inner surface of profemur without tooth or angular prominence

13 (14) Epipleural carina visible from above throughout its entire length, parallel to elytral outline. – Parameres strongly elongate, rectilinearly narrowing to apices (Figs 855, 856 in MEDVEDEV 2001*a*) *Montagona* G. MEDVEDEV, 1998

14 (13) Epipleural carina only partly visible from above

15 (16) Pronotum distinctly cordate, strongly narrowing toward base (maximum width 1.3 times basal width) (Fig. 68 in Medvedev 2001a). Anterior margin of pronotum deeply and arcuately emarginate. Elytra with humeral carina sharp, dorsal surface flat. Ventral surface of all tarsi without hair brushes or tufts. Parameres very short, evenly narrowing apically (Fig. 873 in MEDVEDEV 2001*a*) *Colasia* KOCH, 1965

16 (15) One or more characters not as above: pronotum may not be cordate, with shallowly emarginate anterior margin; humeral carina may not be sharp; hair brushes may be present on basal pro- and mesotarsomeres

17 (18) Parameres more or less evenly narrowing apically, their outer margin slightly arcuately convex (Figs 821–823 in MEDVEDEV 2001*a*). – Epipleural carina not visible from above. Male pro- and mesotarsomeres 1 and 2 with small hair brush at apical margin. Dorsal surface of elytra with 5 longitudinal carinae between sutural margin and outer side of elytra. Humeral carina obsolete *Blaptogonia* G. MEDVEDEV, 1998

18 (17) Parameres sharply narrowing apically, their outer margins more or less arcuately emarginate in dorsal view (Figs 857, 858, 870, 871 in MEDVEDEV 2001*a*)

19 (22) Epipleural carina visible from above in anterior third, sometimes also near apex. Dorsal surface of elytra without longitudinal carinae

20 (21) Epipleural carina visible from above in anterior third and at elytral apices. Plantar surface of male protarsomeres 1 to 3 and mesotarsomere 1 with hair brush. Parameres moderately elongate (1.8 times as long as broad), abruptly narrowing in apical part (Fig. 857 in MEDVEDEV 2001*a*) *Pseudognaptorina* KASZAB, 1977

21 (20) Epipleural carina visible from above in anterior third only. Plantar surface of male protarsomeres 1 to 3 and mesotarsomere 1 without hair brush. Parameres strongly elongate (2.4 times as long as broad), almost cuneately narrowing to apices (Fig. 858 in MEDVEDEV 2001*a*) *Sintagona* G. MEDVEDEV, 1998

22 (19) Epipleural carina not visible from above, concealed by convex lateral part of elytra. – Male protarsomere 1 with small hair brush at apical margin. Dorsal surface of elytra with 2 smooth longitudinal carinae between sutural margin and humeral carina *Nepalindia* G. MEDVEDEV, 1998

VIII (VII) Apical part of ovipositor (coxite) elongate, 1.5–2.3 as long as wide. Lobes of ovipositor with less developed setae, usually almost glabrous. Antennomere 7 not narrower than 8, often broader; if a little narrower, either elytra mucronate, i. e. produced to form tail-like process; or mentum deeply notched; or basal piece of aedeagus strongly narrowing apically, but parameres small, strongly curved upwards; or male abdomen with reddish hairy pit on the border between visible ventrites 1 and 2 subtribe Blaptina LATREILLE, 1817 (type genus: *Blaps* FABRICIUS, 1775)

1 (2) Pronotum elongate, about 1.1 as long as wide. Protibia with one spur. – Male abdomen with reddish hairy pit on the border between visible ventrites 1 and 2. Body slender, strongly elongate *Thaumatoblaps* KASZAB et G. MEDVEDEV, 1984

2 (1) Pronotum clearly transverse. Protibia with two spurs

3 (4) Lower spur of protibia distinctly shorter than outer. – In male, plantar surface of protarsomeres 1 and 2 and mesotarsomere 1 with flattened apical hair brush *Nalepa* REITTER, 1887

4 (3) Apical spurs of protibia subequal in length

5 (12) Upper edge of inner surface of profemur with subapical tooth or angular (sometimes blunt) prominence. Male abdomen always without hairy pit on the border between visible ventrites 1 and 2

6 (7) Male profemur with one tooth on upper edge of inner surface and with another one on lower edge. Female with one tooth on upper edge only. – Parameres broad, equally narrowing toward apex, male with all femora bent in proximal part *Coelocnemodes* BATES, 1879

7 (6) Profemur of both male and female with one tooth on upper edge of inner surface, lower edge without tooth

8 (9) Elytral apex produced, forming tail-like process. Pronotum clearly deplanate along lateral edge. Male metatibia distinctly bent in S-shape. – Tooth on upper edge of profemur sharp, with acute-angled apex. Male pro- and mesotibia with apical spot of small, pale hairs. Plantar surface of protarsomeres 1 to 4 with bunches of pale setae at apex. Parameres strongly narrowing apically *Dilablaps* A. BOGATSHEV, 1976

9 (8) Elytral apex not produced, without tail-like process. If elytra produced, pronotum not deplanate along lateral edge, and male metatibia not S-shaped

10 (11) Pronotum more or less deplanate along lateral edge. Elytra always without longitudinal grooves. Antennomere 7 as wide as or slightly wider than 8. Body ovate *Caenoblaps* KÖNIG, 1906

11 (10) Pronotum evenly convex between lateral edges. Elytra sometimes with longitudinal grooves. Antennomere 7 as wide as or distinctly wider than 8. Body elongate, slender *Dila* FISCHER DE WALDHEIM, 1844

12 (5) Inner surface of profemur without tooth or angular prominence. If profemur with tooth on inner surface (*Blaps femoralis* FISCHER DE WALDHEIM, 1844 of Mongolia), male abdomen with hairy pit on the border between visible ventrites 1 and 2

13 (14) Plantar surface of male protarsomeres 1 to 3 and mesotarsomere 1 with complete hair brush.– Elytral epipleura ending before sutural angle, epipleural carina visible from above throughout its entire length. Elytral apex not produced. Antennomere 7 strongly elongate (2.8 times as long as wide). Common shaft of spiculum ventrale long *Protoblaps* G. MEDVEDEV, 1998

14 (13) Plantar surface of male protarsomeres 1 to 3 and mesotarsomere 1 without hair brush, or much larger setae present on protarsomeres 1 and 2. – Elytral apex often produced, forming tail-like process, or male with hairy pit on the border between visible abdominal ventrites 1 and 2 *Blaps* FABRICIUS, 1775

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A REVISION OF THE PALAEARCTIC SPECIES OF THE EUGRAPHE HÜBNER, [1821] 1816 GENERIC COMPLEX. PART I. THE GENERA EUGRAPHE AND GONIOGRAPHA (LEPIDOPTERA, NOCTUIDAE)

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The Palaearctic species of the wide sense *Eugraphe* are revised, a new genus, *Goniographa* gen. n. and five new species, *G. discussa, G. shchetkini, G. metafunkei, G. naumanni* and *G. gyulaipeteri* spp. n. are described and the genus *Eugraphe* s. str. is redescribed. The *"Eugraphe" ornata* species complex is transferred into *Xestia* (s. l.), with the description of a new species of the group, *X.* (s. l.) *hypographa* sp. n. With 49 genitalia figures and 24 colour pictures.

Key words: Noctuidae, *Eugraphe* (s. l.), *Goniographa*, *Xestia* (s.l.), new genus, new species, new combinations, Eurasia

INTRODUCTION

The first detailed synopsis of the whole genus, together with those of certain other Xestiini genera (like, for instance, *Eugnorisma* BOURSIN, 1946) was published by BOURSIN in 1954. Later, this systematic survey was completed by him (BOURSIN 1963) with the treatment of the other eastern Palaearctic Xestiini, in particular the genus *Amathes* HÜBNER, 1821 (= *Xestia* HÜBNER, 1818). Subsequently, a number of species was additionally included into this genus by POOLE (1989). Some of them have already been studied in detail and removed from *Eugraphe*, e.g. the taxa of *Pseudohermonassa* VARGA, 1990, the members of the *Xestia senescens*-group, the European "*Eugraphe*" *jordani* (TURATI, 1912), see FIBIGER 1997, but the other Asiatic species of the wide sense *Eugraphe* have not been revised yet.

The recent studies on the *Eugnorisma* genus-group have been started still in the mid-eighties, and the results were published in a series of papers (VARGA & RONKAY 1987, VARGA *et al.* 1990, VARGA & RONKAY 1994, VARGA *et al.* 1995, HREBLAY & RONKAY 1998, RONKAY & VARGA, 1999, etc.). The taxa of the genus *Eugraphe* sensu BOURSIN had also been involved into the studies and it was surprisingly found already in the early phase of the investigations that the three

"well-known" species of the *Eugraphe marcida* (CHRISTOPH, 1893) species-group represent in fact three closely related, externally hardly separable twin species. On the other hand, these studies revealed the distinctness of the wide sense "*Eugraphe marcida* lineage" from *Eugraphe* s. str. and from the "*E. denticulata–E. xizangensis*" species pair.

Unfortunately, these new species have long been remained undescribed, due to the limited material available for the studies. It is worth to mention that the three formerly described species were rather poorly represented even in the largest museum collections and were insufficiently documented in the literature. Moreover, the majority of the specimens we had the opportunity to study originate from the collectings of Mrs E. VARTIAN and Prof. Dr C. NAUMANN in NE Afghanistan, although, the type localities of the three formerly described species lie in Central Asiatic part of the former Soviet Union (*E. marcida*: Turkmenistan, *E. decussa* and *E. funkei*: W Tien-Shan Mts). The last decade brought the breakthrough as we could put together the material of several Hungarian expeditions led to Turkmenistan and N Iran, and the large collection materials originating from Uzbekistan, Kazakhstan, Kirghisia and Tadjikistan (for instance, the SHCHETKIN collection, which is owned recently by Hungarian and German private collectors).

Thus, we could compare large series of most species and clarify the taxa of the three main lines of the *E. marcida* species-group. These three lines (the *decussa*-, the *funkei*- and the *marcida*-lines) are proved to represent a separate genus being distinct of *Eugraphe* s. str. The new genus, *Goniographa* contains altogether eight species; the description of the new genus and its five new species, as well as the detailed characterisation of the species groups and the three formerly described species, is given in the Systematic part of this paper. All known species are illustrated in colour, including the holotypes/lectotypes of all but one species (*G. marcida*).

Abbreviations: GYP – GYULAI PÉTER (in slide numbers); HNHM – Hungarian Natural History Museum, Budapest; RL – RONKAY LÁSZLÓ (in slide numbers); VZ – VARGA ZOLTÁN (in slide numbers); ZIN – Zoological Institute, Russian Academy of Sciences, St. Petersburg; ZMHU – Zoological Museum of the Humboldt University, Berlin; ZMUH – Zoological Museum, University of Helsinki; ZSM – Zoologische Staatssammlung, Munich.

SYSTEMATIC PART

THE SURVEY OF THE PALAEARCTIC SPECIES OF EUGRAPHE HÜBNER, [1821] 1816 (S. L.)

The genera *Eugraphe* and the newly described *Goniographa* **gen. n.** belong to the 2nd subgroup of the 8th genus-group sensu LAFONTAINE (1998: 171–172). He has outlined 9 larger, probably monophyletic "generic groups" of Noctuini (sensu LAFONTAINE), based on some imaginal and larval characters. The group (8), called "*Abagrotis* group" consists of 10 Nearctic/Holarctic genera: *Abagrotis*, *Adelphagrotis*, *Agnorisma*, *Parabagrotis*, *Prognorisma*, *Pronoctua*, *Protolampra*, *Pseudohermonassa*, *Setagrotis* and *Tesagrotis*. It is worth to mention, that the Palaearctic *Eugnorisma*, *Metagnorisma*, *Sinognorisma* and some new genera erected by RONKAY and VARGA (1999) belong to the same generic group. Two new genera, *Prognorisma* and *Agnorisma* have been erected and described by LAFONTAINE (1998), and this large and obviously heterogenous group has been subdivided. *Agnorisma*, *Eugnorisma*, *Prognorisma*, *Pseudohermonassa* and *Sinognorisma* have been characterized by having a field of spines at the apex of the aedeagus (i.e. carina) that does not extend onto the vesica (see: LAFONTAINE 1998, VARGA & RONKAY 1987, VARGA *et al.* 1990), and they have been separated from the group of genera consisting of *Adelphagrotis*, *Eugraphe*, *Graphiphora*, *Opigena*, *Parabagrotis* and *Setagrotis* in which a narrow spinulose bar extends from the apex of the aedeagus onto the basal part of the vesica. The very diverse genus *Xestia* probably belongs also to this group, but the spinulose bar mentioned above is often reduced or modified in different subgenera of *Xestia*. Some genera and species groups (tentatively ranked as subgenera) can be clearly characterised by some distinctive characters of the carina and the vesica penis (males) and the ostium bursae–ductus bursae complex, the modifications of the cervix bursae and the apical (posterior) part of the corpus bursae, the presence/absence of the signa etc. (females), respectively. It is found that these characters and, in addition, the ventral, lateral or dorsal projection of the vesica can be used for the characterisation of the different evolutionary lines within the genera/subgenera related to *Xestia* s. l., *Eugraphe*, etc. (*Abagrotis* group sensu LAFONTAINE).

The genus *Hypernaenia* HAMPSON, 1894, has been restituted for the species pair "*Eugraphe*" *denticulata* (WARREN, 1888) (type species of *Hypernaenia*, by monotypy; **stat. rev.**) and its sister species *H. xizangensis* (CHEN, 1982) (**comb. n.**).

The twin species "*E.*" *ornata* (STAUDINGER, 1892) and *X. hypographa* **sp. n.** have been transferred from *Eugraphe* to *Xestia*. The "*senescens*" species group could be recognised also as a well-defined species-group within *Xestia*.

"*Xestia*" *versuta* (PÜNGELER, 1909) will be removed from *Xestia* and its taxonomic relegation will be discussed in a subsequent paper. This species is closely related to the taxa of the newly described *Goniographa* but differs from them by the lack of the generic autapomorphies of *Goniographa* (see in the diagnosis of the new genus).

Eugraphe HÜBNER, [1821] 1816
(Figs 18, 19, 44, 45, 50)

Type species: *Phalaena Noctua sigma* [DENIS et SCHIFFERMÜLLER], 1775.

Taxonomic remarks. A probably monotypic genus, its type species is Trans-Palaearctic. The genus is closely related to *Anagnorisma* RONKAY et VARGA, 1999, *Coenophila* STEPHENS, 1850 (Holarctic), *Eugnorisma* BOURSIN, 1946, and supposedly also to the Nearctic *Eueretagrotis*.

Diagnosis. The external appearance of the only known species of the genus (Fig. 50) is rather different from those of the closely related *Anagnorisma, Eugnorisma* and *Coenophila* (see also FIBIGER 1997), resembling mostly certain species of *Spaelotis* BOISDUVAL, 1840 and also *Graphiphora* OCHSENHEIMER, 1816.

The closest related genus of *Eugraphe*, owing to the genitalia features of both sexes, is *Anagnorisma*, one of the most ancient known groups of the *Eugnorisma–Eugraphe* phyletic line. Their male genitalia differ mainly by the size and structure of the subbasal cornutus which is much stronger, longer in *Anagnorisma* (see RONKAY & VARGA 1999, Figs 21, 22), the presence/absence of the long zone of fine sclerotised ribs in the inner curve of the vesica (present in *Eugraphe*, absent in *Anagnorisma*) and the shape and size of the pollex which is much more lobate in *Eugraphe* than in the *Anagnorisma* species.

The female genitalia of *Anagnorisma* show a less homogeneous picture where the typical features of *Eugraphe* (e.g. the well-developed postero-lateral appendages of the ostium bursae or the medially folded ductus bursae) may appear but in different combinations, and a part of the species still have signa in the corpus bursae.

The main differences between the male genitalia of *Eugraphe* and *Eugnorisma* lie in the aedeagus and the vesica: the aedeagus of *Eugraphe* has a ventral sclerotised bar of the carina extending towards basal part of vesica, terminated in a strong, dentate bulb; the carina of *Eugnorisma* has generally a dorsal (dentated, hooked, etc.) projection, if there is a stronger ventral sclerotisation (in the *E. chaldaica–E. spodia* group), it is always very strong and pyramidal. Another generic apomorphy of *Eugnorisma* is the presence of a distal, smaller or larger, field

of minute cornuti in the vesica, covering often the surface of a subterminal diverticulum; this cornuti field is completely missing in *Eugraphe*.

The most conspicuous differential feature of the female genitalia of *Eugraphe*, as compared with *Eugnorisma*, is the presence of large, heavily sclerotised, terminally rounded postero-lateral appendages of the ostium bursae. The ostium bursae of *Eugnorisma* is also strongly sclerotised, but its caudal margin is more or less straight, except in certain species of the *E. chaldaica* lineage, but is much weaker, therefore the caudal edge of the ostium bursae is only slightly U-shaped. It is worth mentioning that *Paradiarsia* and *Anagnorisma* have such appendages, although those of *Paradiarsia* are considerably smaller and weaker.

Eugraphe differs from *Coenophila*, besides the external dissimilarity, by the presence of the subbasal cornutus of the vesica (it is absent in *Coenophila*), the differently built apical part of the valva and the much longer, slenderer, curved harpe (see FIBIGER 1997, pp. 288–289, figs 193, 194) of the males, the different shape of the postero-lateral appendages of the ostium bursae (they are "bear-ear-shaped" in *Eugraphe*, "mouse-antler"-shaped in *Coenophila*) and the different proportion and shape of ductus bursae and corpus bursae (*Eugraphe* has short but strong, flattened ductus and large, spacious corpus bursae while the ductus bursae of *Coenophila* is long, narrowly tubular since the corpus bursae is rather small, elliptical) of the females.

Redescription. External features (Fig. 50): Medium-sized moths with dark brown ground colour of both wings, forewing costal area suffused with some reddish or ochreous brown scales; orbicular and reniform stigmata sharply marked, blackish, with some reddish-brownish definition, all other markings rather obsolescent; hindwing concolorous dark brown.

Male genitalia (Figs 18, 19): Uncus long and thin, slightly spatulate apically. Valva without cucullus and corona, pointed with a tiny "pseudopollex" laterally. Saccular extension weakly sclerotised. Harpe long, falcate. Juxta shield-shaped with two parallel sclerotised crests apically. Aedeagus long, slightly arcuate, carina weakly sclerotised, with modified, bulbous, dentate ribbon. Vesica saccate, recurved, projecting ventrally; with a small bulbed cornutus in subbasal position.

Female genitalia (Figs 44, 45): Ovipositor rather short, weak; papillae anales finely conical, setose; posterior gonapophyses slender, fine. Ostium bursae large, sclerotized, its ventral plate quadrangular, with large, flattened, somewhat "bear-ear-shaped" postero-lateral appendages. Ductus bursae medium long, flattened, proximally slightly dilated and curved, most parts strongly, granulously sclerotized. Distal part with strong, straight, oblique dorsal crest running from postero-lateral end towards middle of opposite edge. Anterior third with relatively strong wrinkles and ribs, extending deeply towards apical part of bursa copulatrix. Appendix bursae ample, semiglobular, finely wrinkled; corpus bursae long, sacculiform, weakly membranous; signa absent.

Goniographa gen. n.
(Figs 1–14, 24–40, 51–65)

Type species: *Agrotis decussa* STAUDINGER, 1897, *Dt. ent. Z. Iris* **9**: 367. Type locality: Alexander Mts.

Taxonomic remarks. BOURSIN (1954, 1963) noted that 3 species of *Eugraphe* are characterised by some shared genital characters: they have "a very strong pollex, making the distal part of the valva trifid (*marcida, decussa, funkei*)". More exactly: they can be characterised by the presence of an acute, subapical "pseudopollex", originating from the dorsal sclerotised margin of the valva and by the presence of a well-developed lateral pollex, situated close to the basis of the harpe. The apical "pseudopollex" can be evidently derived from the reduced cucullus, a homologous but less strong and acute lobe is present in the genera *Setagrotis*, *Eugraphe*, *Eugnorisma*, *Adelphagrotis*, etc. However, we should suppose that this character can be considered only as a homoplasy, because it may occur in both of the group of Xestiini genera having spinulose sclerotised plate of the carina and also in those genera which have a (variably) dentate bar at the base of the vesica.

The new genus comprises three species-groups (the *decussa-*, the *funkei-*, and the *marcida*-groups) consisting of closely related sister species. (The taxonomic placement of "*Eugraphe*" *versuta* (PÜNGELER, 1909) has remained uncertain, therefore it was not included into *Goniographa*). The external appearance of the species within these species groups are often confusingly similar but even certain species of the *decussa-* and *marcida* species-groups (for instance *G. discussa* and *G. gyulaipeteri*) can be surprisingly similar externally. The differences in the genitalia of both sexes, however, are easily recognisable not only between the three species-groups but also in the twin species of the given species-groups, too.

Synopsis of the species

Goniographa decussa (STAUDINGER, 1897) **comb. n.**
Goniographa discussa **sp. n.**
Goniographa shchetkini **sp. n.**
Goniographa funkei (PÜNGELER, 1901) **comb. n.**
Goniographa metafunkei **sp. n.**
Goniographa naumanni **sp. n.**
Goniographa marcida (CHRISTOPH, 1893) **comb. n.**
Goniographa gyulaipeteri **sp. n.**

Diagnosis. The new genus shows a unical combination of three main autapomorphies in the male genitalia which are as follows: 1) The dorsally projected vesica with dentate eversible ventral bar; 2) The complete lack of any spinulose or

specially modified surfaces on the vesica; 3) The characteristic tripartite appearance of the apical part of the valva, this unique character was already observed and commented by BOURSIN (1964), consisting of the pointed, cuneate valval apex, the also acute and usually strong pseudopollex and the well-developed, cuneate or thorn-like pollex.

The characteristic features of the female genitalia are the sclerotized, rather large, triangular, calyculate or infundibular ventral plate of ostium bursae, separated from the similarly sclerotised ductus bursae by a fine membranous collar; the sclerotized, flattened ductus bursae with stronger or weaker longitudinal suture at the ventral surface; the scobinate-wrinkled apical (posterior) third of the corpus bursae; the membranous, rather small main part of corpus bursae, having no signa.

Most of the related genera have either a strongly sclerotised, plate-like and spinulose carina but without a bar-shaped dentate processus (*Eugnorisma*, *Metagnorisma, Paradiarsia, Anagnorisma* etc.) with ventrally or ventro-laterally projecting vesica. Other genera show some different, often modified forms of the bar-shaped dentate processus, but also combined with ventrally projecting vesica (*Eugraphe, Coenophila*, etc.). Those Xestiini genera which can be characterised with bulbed cornutus of the vesica (e.g. *Eugraphe*, "*Eugnorisma*" *miniago*, some *Lycophotia* spp., *Pseudohermonassa*, etc.) usually have ventrally projected vesica. The externally most similar *Anagnorisma* spp. do not have any dentate processus onto the basal part of vesica but have a thorn-like, not bulbed cornutus and their vesica is projected ventrally. Some species of the highly diverse genus *Xestia* (s. l.) may have dorsally projecting vesica, but in these cases the dentate processus of carina is also dorsal, and the vesica has no cornutus.

The structure of the female genitalia shows close relationships of *Goniographa* with certain species-groups of *Eugnorisma* and *Protognorisma* while it is rather distinct from those of *Eugraphe, Coenophila* or *Metagnorisma*. The female genitalia of *Eugnorisma* is generally more robust than those of *Goniographa*, the ostium is larger, broader but less elongate and less triangular, being more strongly fused with ductus bursae, the ductus bursae is regularly folded (sometimes very strongly, in different directions) and the posterior part of the corpus bursae and the cervix bursae are more ribbed-wrinkled and usually more spacious. The ostium-ductus complex of *Protognorisma* is rather similar to that of *Goniographa* at the first sight but the proportion of them is different, the ostium is smaller, shorter and the ductus is longer than those of *Goniographa*. In addition, *Goniographa* and *Eugnorisma* have no signa while *Protognorisma* (and *Metagnorisma*) have ribbon-like (*Protognorisma*) or patch-like (*Metagnorisma*) signa.

The female genitalia of *Eugraphe* differ from those of *Goniographa*, besides their larger size and more spacious corpus bursae, by the characteristic structure of

the ostium bursae with the long postero-lateral appendages (see above in the diagnosis of *Eugraphe*) and the medially strongly folded ductus bursae.

Description (Figs 51–65). Generally medium-sized species (wingspan 27–37 mm) with rather slender body, elongate, apically pointed forewings and relatively small, rounded hindwings. Head large, eyes large, globular; frons broad, smooth, finely convex, covered relatively sparsely with long hair-scales. Palpi slender, slightly upturned, second segment with longer or shorter scales laterally; third segment bar-shaped, longer (*funkei*-group), medium-long (*decussa*-group) or rather short (*marcida*-group). Proboscis well developed. Male antenna fasciculate with rather long cilia, female antenna shortly, sparsely ciliate. Collar and tegulae large, distinct, pro-and metathoracic tufts well developed. Abdomen long, slender, dorsal crest weak or reduced. Fore tibiae with a full row of longer spines, meso- and hind tibiae with two incomplete rows of spines. Tarsi with rather three than four rows of spines.

Male genitalia (Figs 1–14): Uncus strong, digitiform, often spatulate, pointed or obtuse apically; tegumen high, trigonal; valva elongate, apex bifid apically, pollex long, cuneate, spiniform or sligthly curved; harpe strong, may be short or elongate, curved; juxta shield-shaped. Aedeagus long, straight or slightly curved, carina strongly sclerotised with bar-shaped dentate processus which can be modified into some strongly sclerotised teeth; vesica saccate or tubular, projecting dorsally, partly or fully recurved, armed with broad and most often short, bulbed cornutus in subbasal or medial position.

Female genitalia (Figs 24–40): The female genitalia can be characterized by the weak, relatively short ovipositor; the sclerotized, rather large, more or less triangular ventral plate of the ostium bursae; the strong, often heavily sclerotized, flattened ductus bursae, often with fine longitudinal suture at ventral surface; the well-developed, ribbed-wrinkled, subconical or semiglobular appendix bursae; the scobinate-wrinkled apical (posterior) third of the corpus bursae; and the membranous, elliptical-ovoid main part of corpus bursae, having no signa.

The common species-group features of the three species-groups are described hereunder.

G. decussa-group

Male genitalia (Figs 1–4): Uncus digitiform, of medium length, obtuse terminally; valva with convex dorsal margin, lateral apical extension horn-shaped, longer than the dorsal one; harpe reduced to its basal plate; pollex long, pointed apically, oxbow-shaped. Juxta broad, shield-shaped, with short, bar-shaped sclerotisation apically. Aedeagus long, nearly straight, carina serrate, extended into a long, terminally curved serrate ribbon-shaped bar onto the basal part of the vesica. Vesica bilobate, with a moderately strong bulbed cornutus subterminally.

Female genitalia (Figs 24–29): Ostium bursae with ventral plate shorter or broader triangular or calyculate, having variably strong medio-caudal incision. Ductus bursae variably long, flattened, strongly, sometimes heavily sclerotized, tubular, usually finely tapering towards posterior end, sometimes with large, rounded lateral angle at middle; junction of ventral plate to corpus bursae may be weakly or strongly arched and/or crenellate, or having long and deep, sometimes sinuously folded large crest running into a rather globular, big ventral pouch.

G. funkei-group

Male genitalia (Figs 5–11): Uncus more or less spatulate, pointed terminally; valva very long with nearly straight dorsal margin, slender distally, lateral apical extension acute apically, slightly or essentially longer than dorsal one; harpe strong, curved; pollex strongly developed, pointed apically, with different shape in each species. Juxta relatively small, pentagonal. Aedeagus very long, straight with strongly dentate or finely serrulate carina; dentate bar more or less reduced. Vesica broadly tubular, unilobate, more or less recurved; position and size of bulbed cornutus different in each species.

Female genitalia (Figs 30–35): Ostium bursae with ventral plate triangular, trapezoidal or infundibular, caudal margin slightly convex, arcuate, with variably deep medial incision. Ductus bursae medium-long or long, broadly tubular or cask-shaped, proximal half of ductus bursae may have a long, strong lateral fold along left margin and a stronger lateral rib or a weak, short fold at anterior end. Appendix bursae relatively short, subconical-semiglobular; corpus bursae discoidal-globular.

G. marcida-group

Male genitalia (Figs 12–14): Uncus thin, elongate, pointed apically; tegumen broader, triangular. Valva elongate, narrow, with slightly convex dorsal margin; apical processes thorn-shaped, acute apically; harpe strong, pointed apically; pollex straight, cuneate, pointed apically. Juxta relatively small, shield-like. Aedeagus rather long, carina finely serrate, extended into a finely dentate ribbon-shaped bar onto basal part of the vesica. Vesica tubular, recurved, with short, bulbed cornutus.

Female genitalia (Figs 36–40): Ventral plate of ostium bursae broadly triangular-calyculate, with convex, evenly arcuate caudal margin, without incision. Ductus bursae, long, broad, flattened, anterior end with short but strong medio-lateral crest and a large, rounded, verrucose proximo-lateral plate. Appendix bursae large, subconical, with membranous apex and wrinkled-ribbed, scobinate basal two-thirds or with large, sclerotized, more or less rounded dorsal fold.

Goniographa decussa (STAUDINGER, 1897) **comb. n.**
(Figs 1–3, 24, 25, 51, 52)

Agrotis decussa STAUDINGER, 1897, *Dt. ent. Z. Iris* **9**: 367. Type locality: Alexander Mts.

Type material examined: a syntype male, a colour picture of which and the photo of its genitalia (slide 127 BOURSIN, mentioned as "holotype") are presented in Figs 1 and 51. This specimen is designated here as the lectotype of *Agrotis decussa* STAUDINGER (deposited in coll. STAUDINGER, ZMHU Berlin).

Additional material examined: Uzbekistan: 9 males, 5 females, W Tien Shan, Chimgan Mts, 800–2000 m, 69°58'E, 41°32'N, 18–25.VII.1990, leg. GYULAI & HREBLAY (coll. B. HERCZIG, P. GYULAI, G. RONKAY, Z. VARGA); 1 male, from the same Mts, 1600 m, 20.IX.1992, leg. L. MISKÓ; 1 male, Tien Shan Mts, Maidantal Mts, Pskem valley, 2100 m, 42°11'N, 70°50'E, 28–31.VII.1994; 1 male, W Tien Shan, Chatkal Mts, Besch-Aral, 2200 m, 71°27'E, 42°00'N, 27.VII.1993, leg. V. & A. LUKHTANOV; 1 male, Susamyr Mts, valley of Chickhan river, 1800 m, 29–30.VII.1994, leg. TOROPOV & SINIAEV (coll. P. GYULAI). Kirghisia: Issyk-Kul (coll. P. GYULAI); 1 male, Alai Mts, Uzhgen,

2300 m, 20–30.08.1999, leg. GURKO (coll. LEHMANN); 1 male, Alai Mts, 1800–2000 m, 10–20.VIII. 1999 (coll. BECHER); 1 male, Transili Alatau, 2500 m, Ak-tuz, 1–10.X.1997, leg. TOROPOV (coll. LEHMANN).

Slide Nos RL7545m, RL7546m, 7041VZ, 7156VZ (males), RL7531f (female).

Diagnosis. *G. decussa* resembles mostly the next, newly described species, *G. discussa*, the third species of the species-group, *G. shchetkini* is more similar externally to the small specimens of *G. gyulaipeteri* sp. n. having rounded forewing apex. The forewings of *G. decussa* are more triangular than those of *G. discussa*, apically more pointed, the orbicular, reniform and claviform stigmata are more regular, being defined finely by black scales and by fine ochreous contour-line; the dark intermacular patch in the cell, the basal dash and the subterminal chevron-spots are also more sharply marked. The hindwings are light brownish grey with darker suffusion along the veins.

The male genitalia of *G. decussa* can be distinguished from *G. discussa* by their more convex, "humped" dorsal margin of valva, the more reduced harpe, the broader juxta, the somewhat more slender, not spatulate uncus, the "broken" course of the ribbon-like extension of the carina and by the essentially shorter cornutus. The female genitalia of *G. decussa* have, comparing with those of *G.*



Fig. 1. *Goniographa decussa* (STAUDINGER), lectotype, MB127, male genital capsula

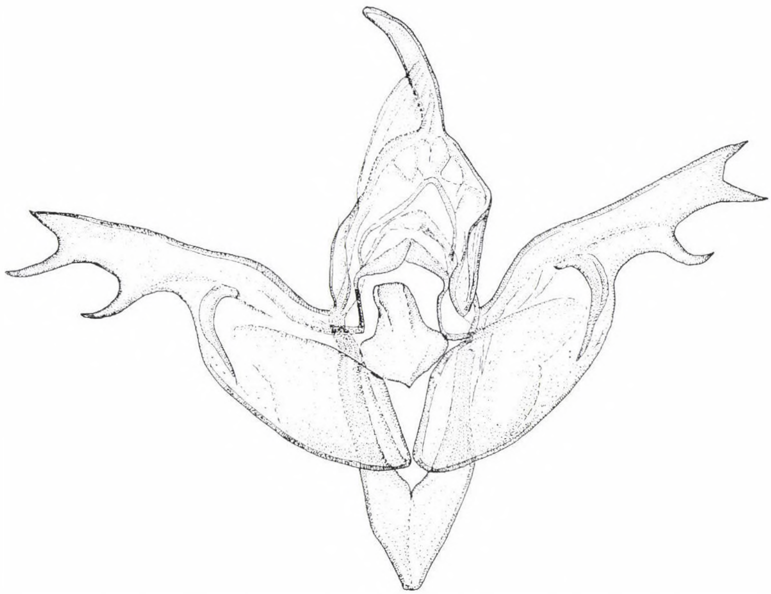


Fig. 2. *Goniographa decussa* (STAUDINGER), slide No. RL7546

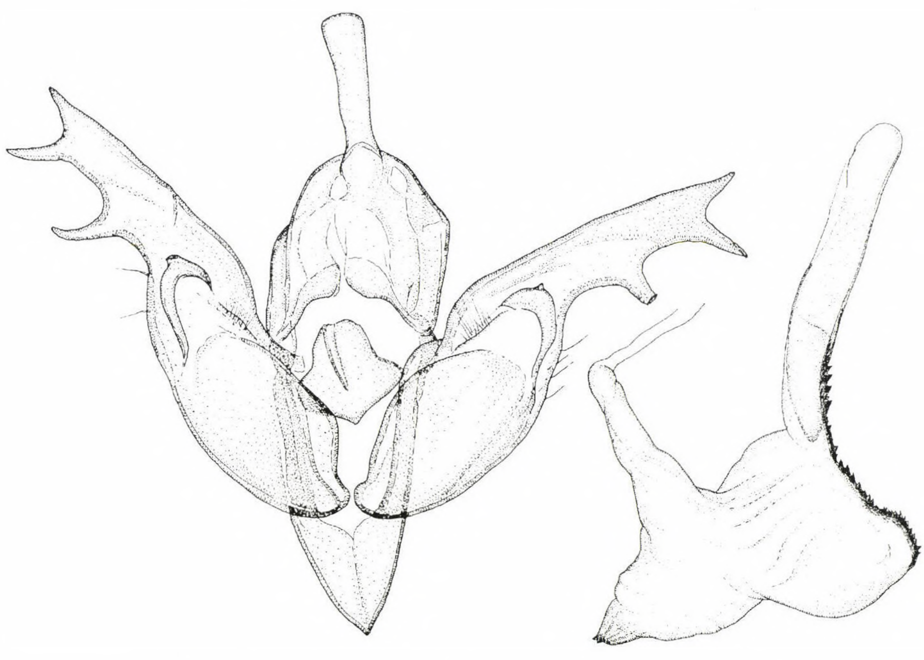


Fig. 3. *Goniographa decussa* (STAUDINGER), slide No. VZ7156

discussa and *G. shchetkini* (Figs 24–29), the largest ostium bursae with the strongest medio-caudal incision. The configuration of the ductus bursae is similar to that of *G. shchetkini* but it is considerably longer, proximally less dilated, without prominent lateral angle and the anterior arch of the ventral plate of ductus bursae is significantly deeper. The characteristic structure of the anterior third of ductus bursae of the third species of the lineage, *G. discussa*, differs conspicuously from those of *G. decussa* and *G. shchetkini* (see also in the diagnoses of the two other species of the lineage).

Description. Wingspan 27–37 mm. The external features are described in detail by STAUDINGER in the original description, two typical specimens are illustrated in colour in Figs 51 and 52.

Male genitalia (Figs 1–3): Uncus straight, obtuse; dorsal costa of valva humped. Distal, erect part of harpe reduced to a tiny protuberance; pollex moderately long, slighly curved; juxta very broad, with small, linguiform appendix apically. Aedeagus nearly straight, moderately long; dentate ribbon of ventral edge of carina "sickle"-shaped, broken medially; bulbed cornutus small, short, often bifid.

Female genitalia (Figs 24, 25): Ovipositor medium-long, rather weak; gonapophyses slender, fine. Ostium bursae sclerotized, its ventral plate broadly triangular, with broad, shallow medio-caudal incision. Ductus bursae strongly, rather smoothly sclerotized, long, broad, more or less flattened (its cross-section is flat triangular at proximal part), finely tapering towards posterior end. Ventral surface of ductus bursae with narrow longitudinal medial suture, junction of ventral plate to corpus bursae strongly arched and crenellate. Apical part of bursa copulatrix globular, wrinkled-ribbed, partly gelatinous and scobinate-verrucose. Appendix bursae relatively short, subconical, finely wrinkled; corpus bursae medium-long, elliptical-ovoid, weakly membranous, signa absent.

Bionomics and distribution. *Goniographa decussa* occurs in the Western Tien-Shan Mts, where it seems to be locally frequent in some lepidopterologically well-known localities, in medium elevations (between 800–2300 m!) of Kirghisia.

Goniographa discussa sp. n.
(Figs 4, 26, 27, 53, 54)

Holotype: male, Seravshan Mts, 45 km SEE Aini, 2000–2600 m, 68°03'E, 39°20'N, 17–18. VII.1994, leg. LUKHTANOV; slide No. RL7544m (coll. P. GYULAI, in HNHM Budapest).

Paratypes. Tadjikistan: 1 female, Pamir Mts, Artuch valley, 2–10.VIII.1988, coll. A.V. NEKRASOV (coll. HNHM Budapest); Pamir Mts, Shugnan, VI.1935, leg. WEIDINGER (coll. G. RONKAY); vic of Shuroabad, 35 km S Kuliabad, 2000 m, 12.VIII.1958, leg. SHCHETKIN; Peter 1st Mts, Chasor Thasma, 2100 m, 13.VII.1977, leg. SHCHETKIN; Peter 1st Mts, Muk, 2100 m, 27.VIII.1975, leg. SHCHETKIN; 1 male, 2 females Peter 1st Mts, Daran-Nazarak valley, Ganishou, 2110 m, 19–21.VIII. 1977, leg. SHCHETKIN; 18 specimens, from the same locality, VII-VIII.1994, leg. SHCHETKIN; 1 m, Peter 1st Mts, Ganishou, 1500–2500 m, 11.VII.2000, leg. RYBAK (coll. LEHMANN); 3 females, Daran-Nazarak valley, 1700 m, 15.VIII.1992, leg. SHCHETKIN; 1 male, 3 females, Karategin range, Sangikar gorge, 1700 m, 28.VIII.1969, leg. SHCHETKIN; 2 males, 2 females, Varzob valley, Maihur, 2000 m, 24.VII.–16.IX.1967, leg. SHCHETKIN; 1 female, Hissar Mts, Anzob pass, 3400 m, 50 km N

Dushanbe, 24–25.VII.1994, leg. LUKHTANOV; 2 males, from the same locality, 26.VIII.1967, leg. SHCHETKIN; 2 males, Hissar Mts, 25 km S Pendzhikent, 1800 m, 10.VII.1994, leg. LUKHTANOV; 1 female, Hissar Mts, Gushary, 1300 m, 18–25.IX.1985, leg. SHCHETKIN (coll. A. BECHER, J. STUMPF and P. GYULAI). Afghanistan: 1 male, Badakhshan, "Sarakanda" 4100 m, 01.18.1953. leg KLAPPERICH (ZSM).

Slide Nos RL7563m, RL7564m, RL7566m, VZ4673, VZ7022 (males), RL7481f, RL7570f, RL7575f (females).

Diagnosis. *G. discussa* has narrower and more rounded forewings comparing with that of *G. decussa*, with generally more obsolescent markings. The maculation of the new species is less conspicuous, with less sharply defined ochreous outlines of the reniform and orbicular stigmata; the claviform stigma is narrower, more obsolescent. The dark intermacular patch of the cell, the basal dash and the subterminal arrowheads are also less sharply marked; the darker suffusion of the hindwing is more diffuse.

Comparing the male genitalia of the two sister species, the uncus of *G. discussa* is slightly broader than in *G. decussa*, slightly spatulate terminally; the valvae have a less convex dorsal costa; the harpe is slightly more elongate; the dentate, ribbon-like extension of the carina is only slightly arcuate, recurved terminally; the bulbed cornutus is more acute and about twice as large as in *G. decussa*.

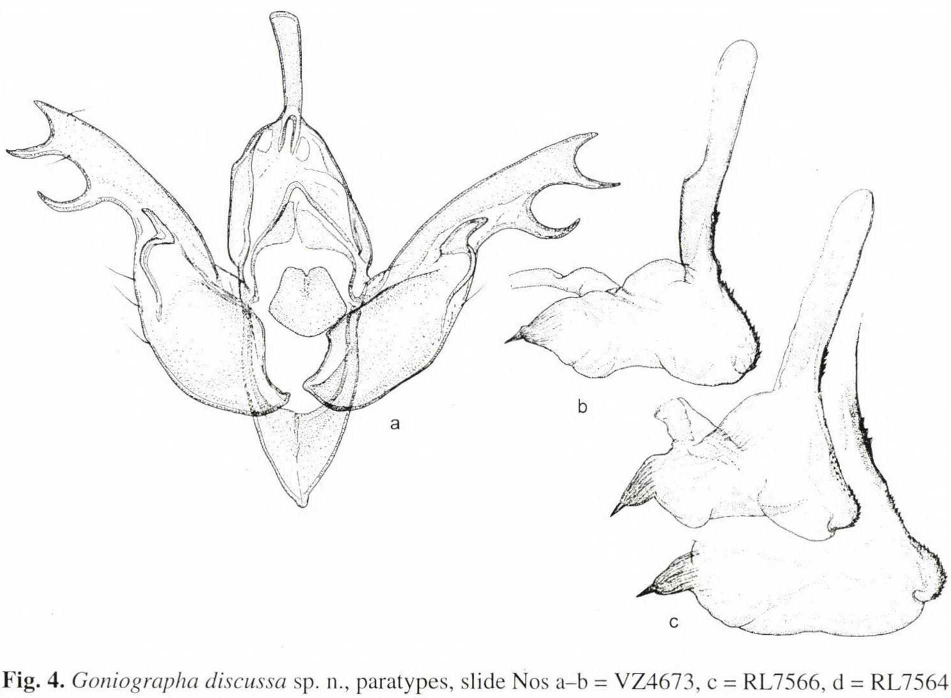


Fig. 4. *Goniographa discussa* sp. n., paratypes, slide Nos a–b = VZ4673, c = RL7566, d = RL7564

The female genitalia of *G. discussa* differ from those of *G. decussa* and *G. shchetkini* by their characteristic, long and deep, sometimes sinuously folded ventral crest of the anterior third of ductus bursae, terminated in a large, more or less globular ventral pouch, both related species have a deeper or shallower arch at anterior edge of ventral plate instead of this structure (see Figs 24–29). The ostium bursae is smaller than that of *G. decussa* but larger than in *G. shchetkini*, the medio-caudal incision is the smallest in *G. discussa*. The anterior third of the ductus bursae is less dilated, its lateral margins are almost parallel, this part is broader (*G. decussa*) or conspicuously broader (*G. shchetkini*) in the two related species.

Description. Wingspan 30–35 mm, length of forewing 13–15 mm. The main external features fit well with those of the *decussa*-group, the differential characteristics are given in the diagnosis. The holotype (male) and a typical female are illustrated in Figs 53 and 54.

Male genitalia (Fig. 4): Uncus slightly broader, slightly spatulate terminally; dorsal costa of valva only slightly convex; harpe small, more elongate; pollex long and curved; juxta shield-shaped with narrow and shallow incision apically; aedeagus straight, long and strong; dentate ribbon slightly arcuate, recurved terminally; bulbed cornutus large, acute.

Female genitalia (Figs 26, 27): Ovipositor medium-long, rather weak; gonapophyses slender, fine. Ostium bursae sclerotized, its ventral plate relatively short, broadly triangular, caudal edge almost straight, with minute medio-caudal incision only. Ductus bursae strongly, granulously sclerotized, more or less flattened, long, broad, with almost parallel lateral margins, only posterior third dilated slightly. Ventral surface of ductus bursae with fine longitudinal medio-lateral suture, anterior third with long and deep, sometimes sinuously folded large crest running into a rather globular, big ventral pouch. Apical part of bursa copulatrix small, flattened-conical, wrinkled, partly gelatinous and scobinate. Appendix bursae rather long, elliptical, finely wrinkled and gelatinous; corpus bursae elliptical-saccate; signa absent.

Bionomics and distribution. *G. discussa* is distributed from the Zeravshan and Hissar Mts through the western Pamir Mts to NE Afghanistan (Prov. Badakhshan), mostly at medium but exceptionally also at rather high elevations.

Etymology. The specific name refers to the less sharply defined markings of the new species.

Goniographa shchetkini sp. n.
(Figs 28, 29, 55)

Holotype: female, Tadjikistan, Pamir Mts, Vanch, Liangar glacier, 4000 m, 20.VIII.1962, ex pupa, leg. SHCHETKIN; slide No. RL7547f (coll. P. GYULAI, in HNHM Budapest).

Diagnosis. The unique type specimen of *G. shchetkini* resembles mostly a small *G. discussa* female but even more unicolorous, with only very weak paler brownish-ochreous irroration but with stronger violaceous hue, the filling of the

orbicular and reniform stigmata is also matching with the violaceous brown ground colour and the fine brownish suffusion of the hindwing is also more concolorous.

The female genitalia of *G. shchetkini* have the smallest ostium bursae and the shortest, proximally conspicuously dilated ductus bursae within the three closely allied species of the *decussa*-line.

Description. Wingspan 31 mm, length of forewing 14 mm. The main external features fit well with those of the *decussa*-group, the differential characteristics are given in the diagnosis. The holotype female is illustrated in Fig. 55.

Female genitalia (Figs 28, 29): Ovipositor medium-long, weak; gonapophyses slender, fine. Ostium bursae sclerotized, small, ventral plate triangular-calyculate, with fine, narrow medio-caudal incision. Ductus bursae heavily sclerotized, relatively short, proximal half considerably broader, with large, rounded lateral angle at middle of left side. Ventral surface of ductus bursae with fine, narrow longitudinal medial suture, junction of ventral plate to corpus bursae forming a rather flat arch. Apical part of bursa copulatrix semiglobular, small, wrinkled-ribbed; appendix bursae relatively long, elliptical, wrinkled. Corpus bursae medium-long, elliptical-ovoid; signa absent.

Bionomics and distribution. A poorly known species, its unique type was collected as a pupa at a high altitude place nearby the Liangar glacier.

Etymology. The new species is dedicated to the late Yuri SHCHETKIN (senior), the famous explorer of the Lepidoptera of the Pamir and the Hissar Mts in Tadjikistan.

Goniographa funkei (PÜNGELER, 1901) **comb. n.**
(Figs 5, 6, 30, 31, 56, 57)

Agrotis funkei PÜNGELER, 1901, *Dt. ent. Z. Iris* **14**: 181. Type locality: Zeravshan Mts.

Type material examined: A syntype male, illustrated in Fig. 56; the labels of the genitalia slide are as follows: "Holotype [printed]/ Agrotis funkei / Pglr. / Sarawschan (2500m) / 30.VI.1900 [handwritten] Boursin [printed]" (red label). This specimen is designated here as the lectotype of *Agrotis funkei* PÜNGELER (in coll. PÜNGELER, ZMHU Berlin).

Additional material examined. Tadjikistan: 4 males, 1 female, Seravshan Mts, 45 km SEE Aini, 2000–2600 m, 68°03'E, 39°20'N, 17–18.VII.1994, leg. LUKHTANOV (coll. P. GYULAI, Z. VARGA), 3 males, Seravshan Mts, Dasht, 2600 m, 68°03'E, 39°20'N, 18–19.VII.1994, leg. LUKHTANOV; 1 male, 2 females, Seravshan Mts, Iskander-kul, 2200 m, 23–25.VII.1968, leg. SHCHETKIN; 1 male, 1 female, Seravshan Mts, 2200 m, 22.VII.1968, leg. SHCHETKIN; 3 males, 3 females, Hissar Mts, Iskanderful, 1900–2300 m, 19–21.VII.1994, leg. LUKHTANOV (coll. P. GYULAI); 1 female, Hissar Mts, Takob, 1900 m, VII.1981, leg. V.V. DUBATOLOV (coll. G. RONKAY); 1 male, 3 females, Hissar Mts, 25 km S Pendzhikent, 1800 m, 10.VII.1994, leg. LUKHTANOV; Hissar Mts, Kvak valley, 1800 m, 21.VII.1960, leg. SHCHETKIN; 9 specimens, Hissar Mts, Takob, Varmonik, 1800 m, 20–21.VII.1961, 14–17.VII.1994, leg. SHCHETKIN; 5 specimens, Hissar Mts, Kondara valley, 1800 m, 21.VIII.1955, 20.VIII.–1.IX.1994, leg. SHCHETKIN; 1 male, Hissar Mts, Kabuty, 1950 m, 10.VII.1961, leg. SHCHETKIN; 1 male, Hissar Mts, Acrobat valley, 1600 m, 1–10.X.1997, leg. V. GURKO (coll. L. LEH-

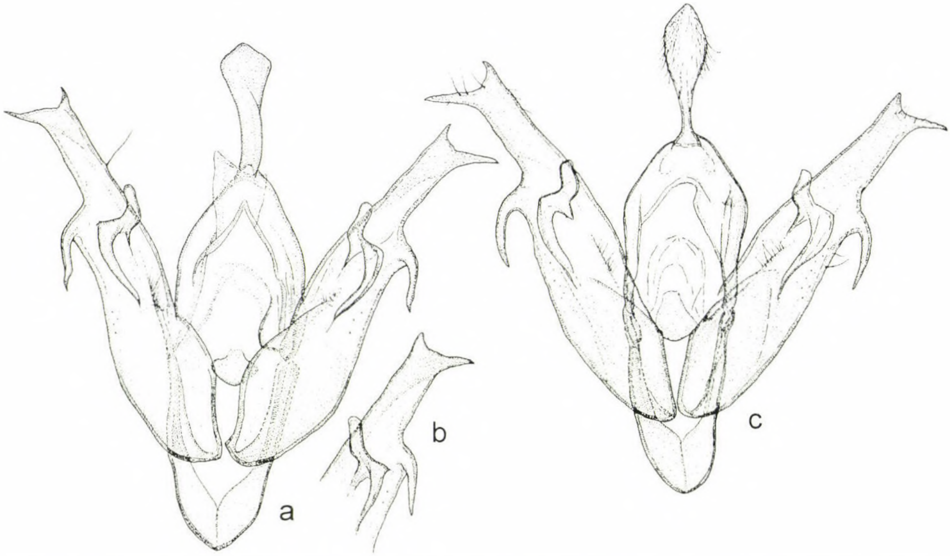


Fig. 5. *Goniographa funkei* (PÜNGELER), slide Nos a = VZ7151, b = VZ7152, c = VZ7043

MANN) 1 female, Varzob valley, 2000 m, 1.VIII.1967, leg. SHCHETKIN; 6 females, Varzob valley, Maihur, 2000 m, 12.VIII.–16.IX.1967, leg. SHCHETKIN (coll. P. GYULAI); 2 females, Pamir Mts, Artuch valley, 2–10.VIII.1988, coll. A.V. NEKRASOV (coll. HNHM Budapest and G. RONKAY); 3 females, Karategin range, Sangikar gorge, 1700 m, 28.VIII.1969, leg. SHCHETKIN; 1 male, from the same site, 1–4.IX.1994, leg. SHCHETKIN; 3 females, Peter 1st Mts, Daran-Nazarak valley, Ganishou, 1700 m, 5–13.VIII.1972, leg. SHCHETKIN; 1 male, from the same locality, 8–27.VIII.1974, 21–22.

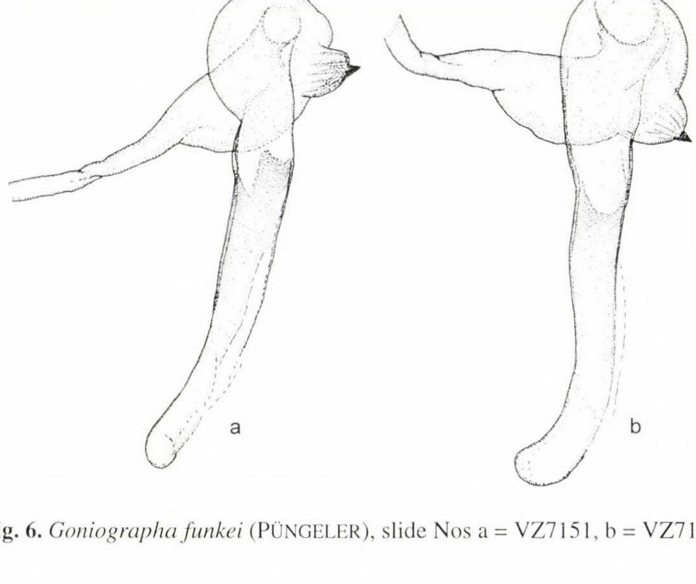


Fig. 6. *Goniographa funkei* (PÜNGELER), slide Nos a = VZ7151, b = VZ7152

VIII.1994, leg. SHCHETKIN; 1 male, 5 females, Peter 1st Mts, Daran-Nazarak valley, Ganishou, 2100 m, 8.VIII.1974, 17–18.VIII.1994, leg. SHCHETKIN; 2 females, Turkestan Mts, Shahristan pass, Kushikat, 3100 m, 26–28.VII.1994; 2000 m, 5–8.VI.1994, leg. LUKHTANOV (coll. P. GYULAI and J. STUMPF).

Slide Nos GYP1564m, RL7549m, RL7551m, RL7576m, RL7577m, RL7582m, 7043VZ, 7151VZ, 7152VZ, 7154VZ (males), RL7480f, RL7553f, RL7554f, RL7556f, RL7557f, RL7558f, RL7579f, RL7580f, RL7585f, RL7586f, RL7589f, RL7590f (females).

Diagnosis. The forewing pattern of *G. funkei* is the most distinct within the *funkei*-group, even in case of the darkened specimens (see Figs 56–61), the forewing of *G. funkei* is somewhat broader than that of *G. metafunkei*. No further key features can be found for the three closely related species of the group, the satisfactory identification requires the study of the genitalia.

The male genitalia of *G. funkei* differ from those of *G. metafunkei* by the shape of the pollex bending characteristically down (proximo-ventrally) (see Figs 5–8), the narrower distal part of the valva with longer "pseudopollex" and the much shorter cornutus of the vesica sitting usually on a somewhat broader bulb. The differences between *G. funkei* and *G. naumanni* are much more prominent as *G. funkei* has much shorter harpe, downwardly bent pollex (it is curved upwards in *G. naumanni*) and smooth carina (which is armed with large, heavily sclerotised teeth in *G. naumanni*).

The female genitalia of *G. funkei* differ from its sibling species, *G. metafunkei*, by their shorter ostium bursae, significantly shorter but somewhat broader ductus bursae having only weak lateral fold and short, less sclerotized proximo-lateral rib(s) and shorter, apically more rounded appendix bursae (see Figs 30–33). The female genitalia of the third species of the *G. funkei* group, *G. naumanni*, is conspicuously different from those of the two closely allied taxa by their heavily sclerotized, much broader and entirely flattened, rather cask-shaped ductus bursae, fused firmly with the relatively short but broad, trapezoidal ostium bursae (Figs 34, 35).

Description. Wingspan 32–36 mm, length of forewing 15–17 mm. The main external features are fairly characterised by PÜNGELER in the original description, the slight differential characteristics are given in the diagnosis. The lectotype (male) and a typical female are illustrated in Figs 56 and 57.

Male genitalia (Figs 5, 6): The typical features of the species group are given in the diagnosis of the genus. Distal part of valva narrow, with more or less parallel margins; valval apex fine, acute, "pseudopollex" long, straight. Harpe rather short; pollex long, thin, bent downwards. Aedeagus long and thin, slightly arcuate; carina smooth. Vesica relatively small, short, recurved, with a short but broadly bulbed cornutus.

Female genitalia (Figs 30, 31): Ostium bursae sclerotized, ventral plate triangular, caudal margin slightly convex, arcuate, with rather deep medial incision. Ductus bursae medium-long, broadly tubular, flattened, granulously sclerotized, finely tapering towards ostium bursae. Proximal half of ductus bursae slightly curved laterad, often with lateral rib or a weak, short fold at anterior end; junction to corpus bursae with short, ribbed lamina at inner curve. Apical part of bursa copulatrix wrin-

kled-ribbed, partly gelatinous and scobinate-verrucose. Appendix bursae relatively short, subconical-semiglobular; corpus bursae discoidal-globular, weakly membranous; signa absent.

Bionomics and distribution. *Goniographa funkei* has the largest distribution in this species group. The type locality is the Zeravshan range, the area of the species covers the western Tien-Shan Mts (Turkestan Mts, Karategin range, Peter I. Mts, etc.), the Hissar Mts and also the western parts of the Pamir massif, where it occurs sympatrically with *G. naumanni*.

Goniographa metafunkei sp. n.
(Figs 7, 8, 32, 33, 58, 59)

Holotype: female, Kirghisia, Susamyr Mts, valley of Chickhan river, 1800 m, 29–30.VII.1994, leg. TOROPOV & SINIAEV; slide No. RL7528f (coll. P. GYULAI, in HNHM Budapest).

Paratypes. Kirghisia: 4 males, 2 females, Susamyr Mts, valley of Chickhan river, 1800 m, 29–30.VII.1994, leg. TOROPOV & SINIAEV; 2 males, 1 female, Alai Mts, Tengizbai, 27.VII.1994, leg. TOROPOV & SINIAEV; 2 males, 1 female, Talassky Alatau Mts, Kara-Bura pass, 1800 m, 42°18'N, 71°35'E, 29.VII.1993, leg. V. & A. LUKHTANOV (coll. P. GYULAI and G. RONKAY); 2 males, 1 female, Kirghiz Mts, Kara Baitta valley, Sosnovka, 1600 m, 6.VIII.1999, leg. PLYUSHCH (coll. A. BECHER, L. LEHMANN & J. STUMPF).

Slide Nos GYP687m, RL7548m, RL7578m, RL7587m (males), RL7581f, RL7588f (females).

Diagnosis. *Goniographa metafunkei* differs from the two closely allied species by its slightly (but in larger material clearly recognisable) smaller size and narrower forewing and the rather strong and blurred dark irroration. The male genitalia of *G. metafunkei* differ from those of *G. funkei* by their broader distal part of the valva, the straight, oblique, thorn-like pollex and the significantly larger cornutus of the vesica; from *G. naumanni* by its shorter harpe, broader distal part of the valva, the straight, distally not upcurved pollex and the smooth carina.

The female genitalia of *G. metafunkei* can be characterized by its long, narrowly tubular ductus bursae with relatively strong, long proximo-lateral fold and the presence of a long, curved, sclerotized ribbon connecting the anterior end of ductus bursae with the inner curve of appendix bursae. The ductus bursae of the new species is the longest within the *G. funkei* group, the ostium bursae is longer, more infundibular, medio-caudally less incised than in *G. funkei* and the appendix bursae is longer, more conical, apically less rounded (see Figs 30–33).

Description. Wingspan 30–35 mm, length of forewing 13–15 mm. The main external features fit well with those of the *funkei*-group, the differential characteristics are given in the diagnosis. The holotype (female) and a typical male are illustrated in Figs 58 and 59.

Male genitalia (Figs 7, 8). The specific features of *G. metafunkei* are as follows: Distal part of valva rather broad, apical process and "pseudopollex" relatively broad, triangular. Harpe rather short;



Fig. 7. *Goniographa metafunkei* sp. n., paratype, slide No. GyP687

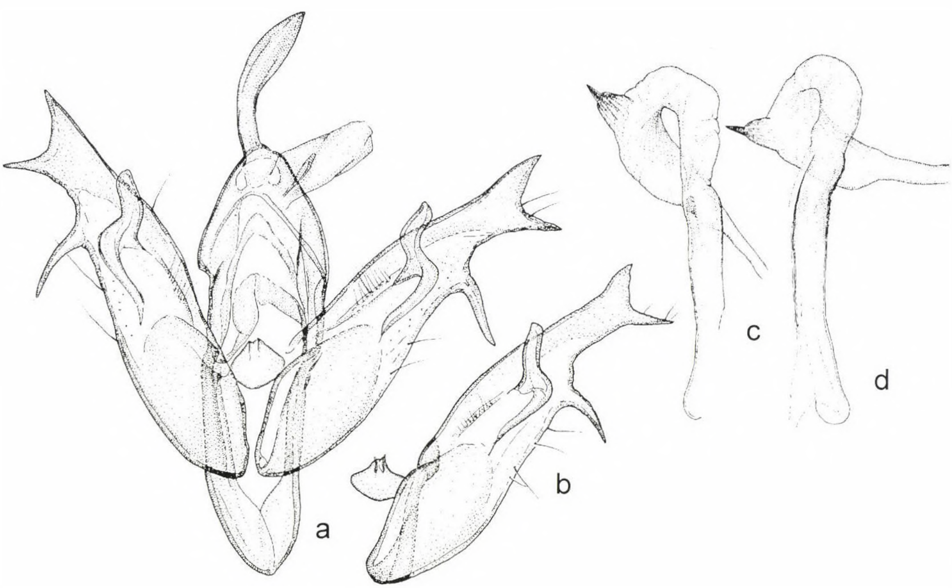


Fig. 8. *Goniographa metafunkei* sp. n., paratypes, slide Nos a–b = RL7548, c–d = RL7578

pollex long, straight, oblique. Aedeagus long and thin, slightly arcuate; carina smooth. Vesica relatively small, short, recurved, with long, strong, bulbed cornutus.

Female genitalia (Figs 32, 33): Ovipositor short, weak; posterior gonapophyses medium-long, slender, fine, anterior apophyses short. Ostium bursae sclerotized, its ventral plate elongate, triangular-infundibuliform, caudal margin slightly convex, arcuate, with shallow medial incision. Ductus bursae long, tubular, flattened, granulously sclerotized, finely tapering towards ostium bursae. Proximal half of ductus bursae with long, strong lateral fold along left margin; junction to corpus bursae with long, cristate-ribbed lamina at inner curve. Apical part of bursa copulatrix wrinkled-ribbed, partly gelatinous and scobinate-verrucose. Appendix bursae medium-long, elliptical-subconical, finely wrinkled; corpus bursae discoidal-globular, weakly membranous, signa absent.

Bionomics and distribution. The new species has a very strictly limited distribution in the western part of the Tien-Shan massif and the Alai Mts.

Etymology. The new species follows *G. funkei* in the system.

Goniographa naumanni sp. n.
(Figs 9–11, 34, 35, 60, 61)

Holotype: male, "Afghanistan, Badakhshan, Darrah-e-Kuf, 2480 m, 16.07.1972., leg. BRADE & NAUMANN"; slide No. VZ4634 (coll. Z. VARGA).

Paratypes. Afghanistan: 1 male, 1 female, Prov. Kadaghan, Salang-Paß N-Seite, 2400 m, 11–12. VII.1971. leg. VARTIAN; 1 male, Khurd-Kabul, 5.VII.1963. leg. KASY & VARTIAN, 1 male, Dasht-i-Nawar, Hokak, 2850 m, 7–9.IX.1963. leg. VARTIAN (coll. Z. VARGA); 1 male, Badakhshan, Darwaz, Shewa plateau, Darrah-e-Gulistan, 2800 m, 21.VIII.1973, 1 male, Badakhshan, Darwaz, Shewa valley, Basindj, 1900–2000 m, 27.VIII.1973., leg. Naumann & Nauruz. (coll. NAUMANN). Tadjikistan: 1 male, Pamir Mts, Shugnan, VII.1935, leg. WEIDINGER (coll. G. RONKAY); 9 males, 12 females, Pamir Mts, Chorog, July–August 1963–65, leg. SHCHETKIN; 1 female, from the same locality, 11.VIII.1992, leg. SHCHETKIN; 1 female, from the same site, 29–31.VII.1999, leg. SHCHETKIN; 1 female, Pamir Mts, Shod, 2300 m, 20.X.1987, leg. NEKRASOV (coll. P. GYULAI and J. STUMPF).

Slide Nos RL7552m, RL7555m, VZ3634; VZ3635, VZ3685, VZ4640, VZ7032, VZ7153 (males), RL7583f, RL7584f (females).

Diagnosis: The new species is almost equal in size with *G. funkei*, although the forewings are slightly narrower triangular with less pointed apex. Forewing colouration and pattern of the two species are highly similar, ground colour of *G. naumanni* is somewhat more ochreous grey, the postmedian line is less evenly curved and crenulate, the claviform stigma is slightly shorter and more obsolescent and the hindwing is a bit more suffused marginally. The satisfactory separation of the two species requires the study of the genitalia. This process is much easier in the females, as no dissection is needed to recognise the differences of the ostial plate.

The male genitalia of *G. naumanni* differ conspicuously from those of the two twin species by its considerably longer harpe, distally upcurved ("oxbow"-

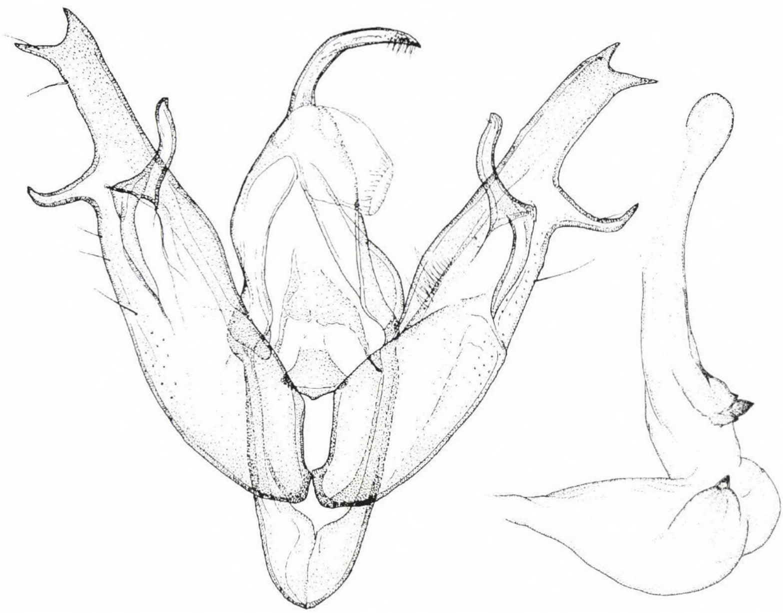


Fig. 9. *Goniographa naumanni* sp. n., holotype, slide No. VZ4634

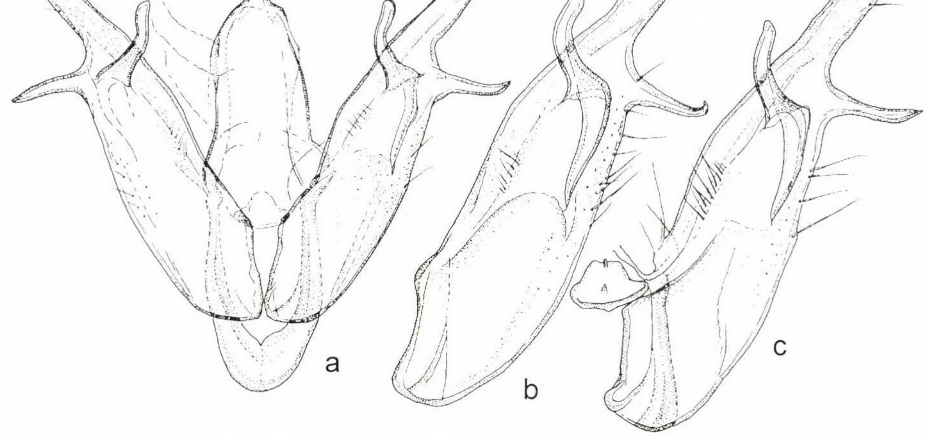


Fig. 10. *Goniographa naumanni* sp. n., paratypes, slide Nos a = VZ3634, b = VZ4640, c = VZ3635

shaped) pollex, the much stronger sclerotised carina bearing 2–3 large, acute teeth and the presence of a huge subbasal diverticulum of the not fully recurved vesica.

Comparing the female genitalia of *G. naumanni* with those of its two sister species, *G. naumanni* has conspicuously broader but shorter, trapezoidal, not triangular-infundibular ostium bursae and much stronger, heavily sclerotized, very broad, not tubulat but more or less cask-shaped ductus bursae.

Description. Wingspan 32–37 mm, length of forewing 14–17 mm. The main external features fit well with those of *G. funkei*, with only a bit more diffuse dark forewing markings. The holotype (male) and a typical female are illustrated in Figs 60 and 61.

Male genitalia (Figs 9–11). The specific features of the male genitalia are the long, slender harpe, the long, distally arched ("oxbow"-shaped) pollex, the nearly straight aedeagus with two or three large, pyramidal teeth on the ventral edge of the carina, the dorsally upturned but not fully recurved vesica with elliptical subbasal diverticulum and with short and strong submedial bulbed cornutus.

Female genitalia (Figs 34, 35): Ovipositor short, weak; posterior gonapophyses medium-long, slender, fine, anterior apophyses short. Ostium bursae relatively short but broad, trapezoidal, with strongly convex, medially slightly incised caudal margin. Sclerotizations of ostium bursae and ductus bursae almost completely fused with each others. Ductus bursae heavily sclerotized, medium-long, broad, rather cask-shaped, with strongly tapering proximal third. Apical part of bursa copulatrix finely scobinate, partly wrinkled-ribbed, partly gelatinous. Appendix bursae subconical, finely wrinkled and verrucose; corpus bursae elliptical-ovoid, signa absent.

Bionomics and distribution. The new species seems to be confined to the Hissar Mts, the western Pamir Mts (Shugnan range, Chorog) and the north-eastern territories of Afghanistan (Prov. Badakhshan, Kadaghan and Darwaz Mts). In the north-west, there is a narrow overlap between the

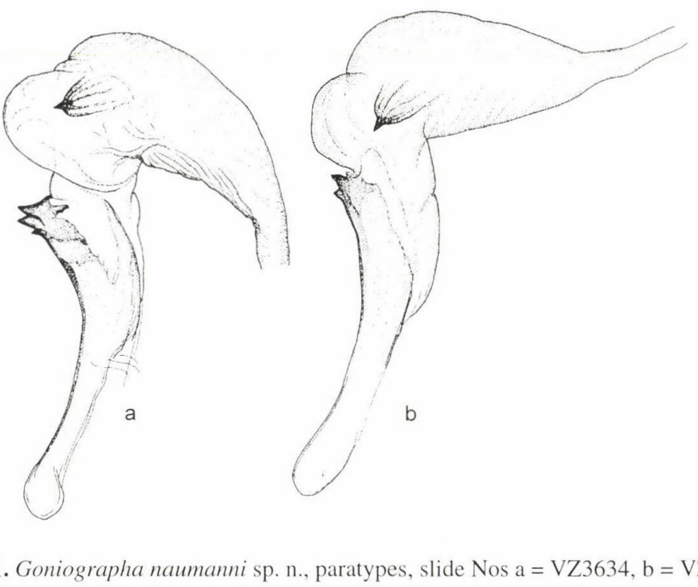


Fig. 11. *Goniographa naumanni* sp. n., paratypes, slide Nos a = VZ3634, b = VZ3635

areas of *G. funkei* and *G. naumanni*; the south-eastern boundary of the distribution of the new species is the Paghman Mts near Kabul (Khurd-Kabul).

Etymology. The new species is dedicated to one of its collectors, the prominent entomologist, Prof. Dr. Clas M. NAUMANN, who has made several important entomological discoveries in Afghanistan.

Goniographa marcida (CHRISTOPH, 1893) **comb. n.**
(Figs 12, 36, 37, 62, 63)

Agrotis marcida CHRISTOPH, 1893, *Dt. ent. Z. Iris* **6**: 90. Type locality: Askhabad (Turkmenistan: Ashgabat).

Type material examined: 1 male, 1 female syntypes, Turkmenistan, Askhabad (ZIN St. Petersburg).

Additional material examined: Turkmenistan: 2 males, 2 females, Kopet-Dagh Mts, Firyuza, 400–600 m, 25.IX.1991, No. L27, leg. A. PODLUSSÁNY, L. RONKAY & Z. VARGA; 4 males, 12 females, Kopet-Dagh Mts, Karayalchi, 1600 m, 5.X.1991, No. L36, leg. A. PODLUSSÁNY, L. RONKAY & Z. VARGA (coll. HNHM Budapest, B. HERCZIG, P. GYULAI, G. RONKAY and Z. VARGA). Iran: 1 male, 1 female, Prov. Khorassan, Kopet-Dagh Mts, 2300 m, 10 km N Jevenly, 27.VIII.2000, leg. A. GARAI & P. GYULAI; 5 males, 5 females, Prov. Khorassan, Kopet-Dagh Mts, Jozak NP, 2 km W Jozak, 1350 m, 28.VIII.2000, leg. A. GARAI & P. GYULAI (coll. P. GYULAI).

Slide Nos RL7476m, 7030VZ (males), RL7477f, RL7569f, RL7574f (females).

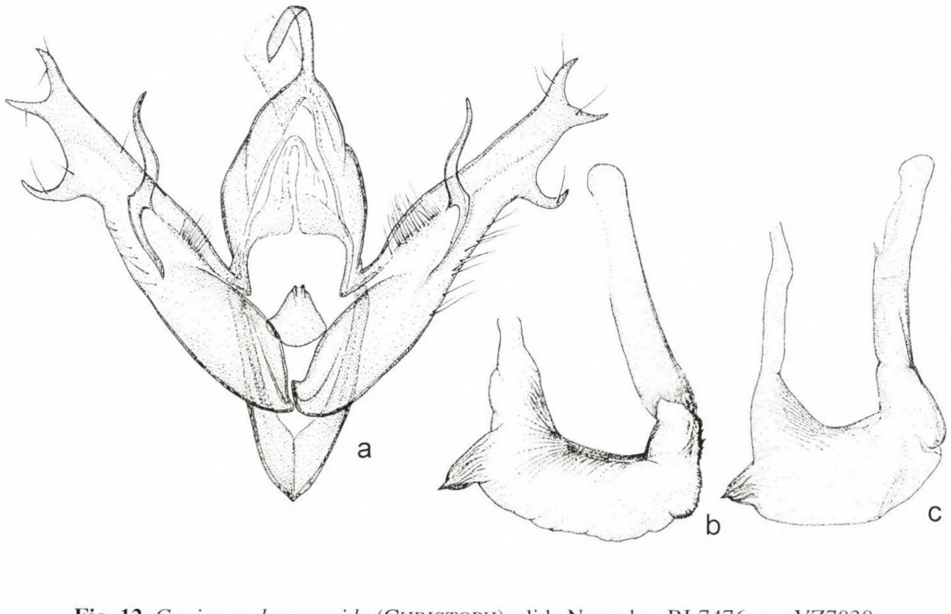


Fig. 12. *Goniographa marcida* (CHRISTOPH), slide Nos a-b = RL7476, c = VZ7030

Diagnosis: *Goniographa marcida* differs from its sister species, *G. gyulaipeteri* by its generally more unicolorous brownish forewings with less intense paler irroration in the median area and by the rather concolorous brown hindwings of both sexes (the inner area of the hindwing is much paler, often prominently whitish in *G. gyulaipeteri*).

Comparing the male genitalia of *G. marcida* and *G. gyulaipeteri*, the distal part of valva of *G. marcida* has longer processus, with more arcuate pollex originating rather far from "pseudopollex", these processi are shorter in *G. gyulaipeteri* and the "pseudopollex" is situated almost at the "halfway between valval apex and pollex. The harpe of *G. marcida* is somewhat longer, S-shaped, the juxta is narrower than in its sister species. The configuration of the vesica also shows easily recognisable differences as the vesica of *G. marcida* is upturned dorsally but not recurved as in *G. gyulaipeteri* (see Figs 12–14), and the cornutus is longer, narrower with smaller basal bulb.

The female genitalia of the two closely related species, *G. marcida* and *G. gyulaipeteri*, differ conspicuously by their appendix bursae (Figs 36–40) which is membranous-scobinate in *G. marcida* while *G. gyulaipeteri* has a large, strongly sclerotized dorso-medial fold. The ostium bursae of *G. marcida* is broader, shorter, without caudal incision, the proximal part of the ductus bursae is finely curved laterad, having short but strong medio-lateral crest and rounded, verrucose ventral plate while the ductus bursae of *G. gyulaipeteri* is straight, having more or less parallel margins, without proximo-lateral crest and verrucose plate.

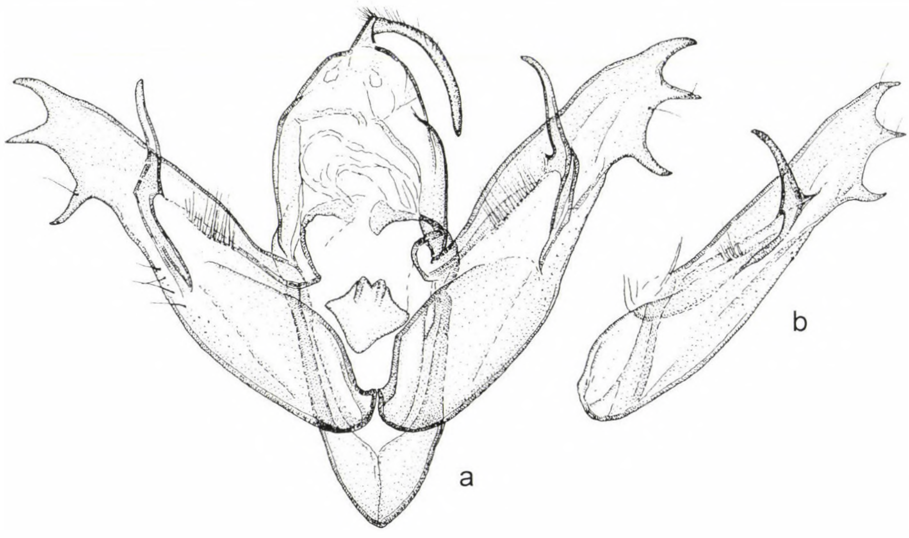


Fig. 13. *Goniographa gyulaipeteri* sp. n., paratypes, slide Nos a = RL7479, b = VZ4643

Description. Wingspan 27–35 mm, length of forewing 12–16 mm. The characterisation of the external features is rather laconic in the original (Latin) description and the measures are somewhat larger ("length of forewing 14–17 mm). The colour pictures of a typical male (from Iran, Khorassan) and a typical female (from the Kopet-Dagh, Turkmenistan) are given in Figs 62 and 63.

Male genitalia (Fig. 12): Uncus strong, pointed; valva straight, elongate with nearly parallel margins; harpe arcuate and pointed; pollex spine-shaped, slightly curved; juxta shield-shaped, narrower apically; aedeagus strong, dentate ribbon with fine teeth, recurved terminally, vesica broad, saccate, only moderately recurved, with a short, acute bulbed cornutus in submedial position.

Female genitalia (Figs 36, 37): Ovipositor rather short, weak; gonapophyses slender, fine. Ostium bursae sclerotized, its ventral plate broadly triangular-calyculate, caudal margin convex, evenly arcuate, without incision. Ductus bursae, long, broad, flattened, strongly, granulously sclerotized, anterior end with short but strong medio-lateral crest and a large, rounded, verrucose proximo-lateral plate. Ventral surface of ductus bursae with narrow longitudinal medial suture. Apical part of bursa copulatrix membranous, wrinkled-ribbed; appendix bursae large, subconical, with membranous apex and wrinkled-ribbed, scobinate basal two-thirds. Corpus bursae small, elliptical-ovoid, weakly membranous; signa absent.

Bionomics and distribution. *Goniographa marcida* seems to be confined to the Kopet-Dagh mountain system, both in Turkmenistan and Iran (Khorassan region).

Goniographa gyulaipeteri sp. n.
(Figs 13, 14, 38–40, 64, 65)

Holotype: female, Tadjikistan, cca 25 km from Kirovabad, at the road to Parkhar, 800 m, 12.X.1960, leg. Y.L. SHCHETKIN, slide No. RL7568f (coll. P. GYULAI, in coll. HNHM Budapest).

Paratypes. Tadjikistan: 3 males, 8 females, Hissar Mts, Kondara valley, 1900 m, 24.IX.1979, coll. A. V. NEKRASOV (coll. HNHM Budapest, B. HERCZIG and G. RONKAY); 2 males, 8 females, from the same valley, August–September 1954–56, leg. SHCHETKIN; 1 female, Hissar Mts, Kondara valley, 1800 m, 20.VIII.–1.IX.1994, leg. Y. SHCHETKIN; 8 specimens, Hissar Mts, Kondara valley, 1100 m, 2–9.IX.1994, leg. Y. SHCHETKIN; 1 female, from the same valley, 1100 m, 20.IX.1979, leg. PLYUSHCH; 9 specimens, Hissar Mts, Gushary, 1300 m, 22–31.VIII.1965, 17–25.IX.1985, 18.VIII. 1992, leg. SHCHETKIN; 1 female, Hissar Mts, Ramit, 18.IX.1950, leg. SHCHETKIN; 1 female, Hissar Mts, Kvak valley, 1800 m, 9.IX.1954, leg. SHCHETKIN; 1 male, 2 females, cca 25 km from Kirovabad, 800 m, 30.VIII.1958, 12–13.X.1960, leg. Y.L. SHCHETKIN; 3 males, 5 females, Obichingou river, n. Tawildara, 1850 m, 2–4.IX.1970, leg. SHCHETKIN; 1 male, Peter 1st Mts, Darai-Nazarak valley, 1700 m, 26.VII.–3.VIII.1992, leg. SHCHETKIN; 1 female, Peter 1st Mts, 2180 m, 16.VIII.1977, leg. SHCHETKIN (coll. A. BECHER, P. GYULAI & J. STUMPF); 2 females, vic. Dushanbe, 750 m, 3.IX.1970, leg. SHCHETKIN; Pamir Mts, Shugnan Mt., Sangan-dara, 3650 m, 23.VII.2000, leg. Y. SHCHETKIN (coll. G. RONKAY). Uzbekistan: Kara-tyube, S of Samarkand, 10–18.VIII.1896, leg. VERIGIN (coll. Z. VARGA); 2 females, Alai Mts, Dugobo, 2600 m, 16.VIII.1985, leg. DANILEVSKY (coll. HNHM Budapest); 1 male, 2 females, W Tien Shan Mts, Chatkal, 1600 m, 30.VIII.–1.IX.1997; 4 females, Seravshan Mts, Kitab, 1400–1600 m, 10–20.X.1997 (coll. A. BECHER & J. STUMPF). Afghanistan: Badakhshan, Darwaz, Shewa valley, Basindj, 1900–2000 m, 27.VIII.1973, Nr. 1421, leg. C. NAUMANN (coll. NAUMANN).

Slide Nos RL7479m, RL7572m, 3686VZ, 4643VZ, 7155VZ (males), RL7478f, RL7501f, RL7502f, RL7567f, RL7571f, RL7573f (females).

Diagnosis. The detailed comparison of the two species are given in the diagnosis of *G. marcida*. A short summary of the specific features of *G. gyulaipeteri* are as follows: the median area of the forewing has stronger pale ochreous(-brownish) irroration, the filling of the stigmata is also paler; the inner area of the hindwing is whitish in both sexes, in certain male specimens the whole wing is whitish with weak darker marginal suffusion only (these specimens resemble also *G. decussa* and *G. discussa*, but their crosslines are less prominent, the wing is less variegated, and the genitalia of the two species-groups show easily recognisable differences).

The male genitalia of *G. gyulaipeteri* are characterised by the rather uniform tripartite distal part of valva with relatively short processi, the shorter, more arcuate harpe, the subdeltoidal, rather broad juxta, the fully recurved vesica with short cornutus sitting on a broad, semiglobular basal bulb (see Figs 13, 14).

The female genitalia of *G. gyulaipeteri* differs from its twin species by its longer, narrower ostium bursae, having shallow medio-caudal incision, longer ductus bursae without anterior crest and ventral verrucose plate and by the presence of a large, strongly sclerotized dorso-medial fold on the appendix bursae which is completely missing in *G. marcida*.

Description. Wingspan 27–35 mm, length of forewing 12–15 mm. The main external features of the species and the diagnostic external characteristics are given in the diagnoses of *G. marcida* and *G. gyulaipeteri*. The holotype (female) and a typical male are illustrated in Figs 64 and 65.

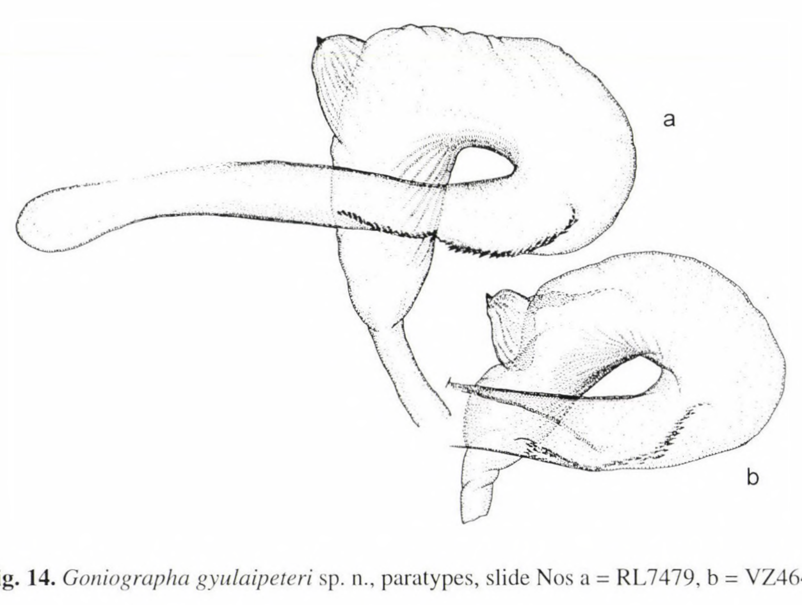


Fig. 14. *Goniographa gyulaipeteri* sp. n., paratypes, slide Nos a = RL7479, b = VZ4643

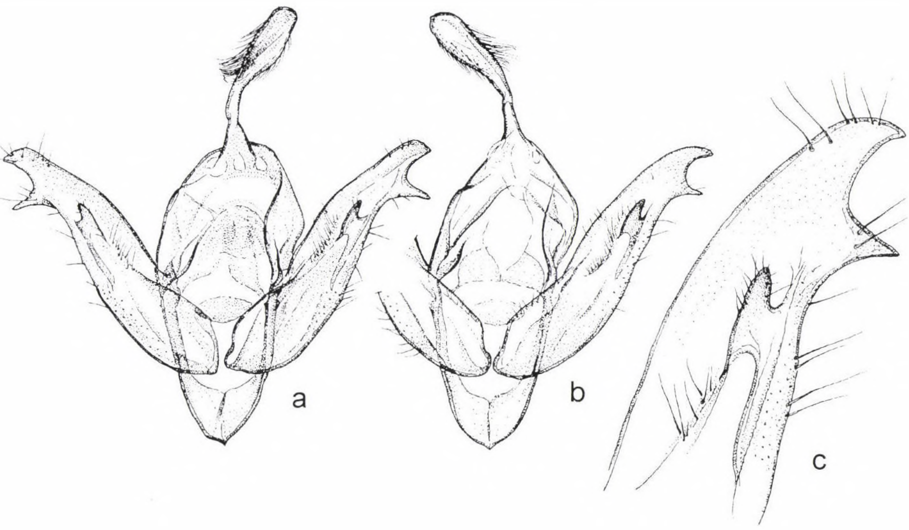


Fig. 15. *Xestia (s.l.) ornata* (STAUDINGER), slide Nos a = VZ7047, b = VZ7065, c = RL7483

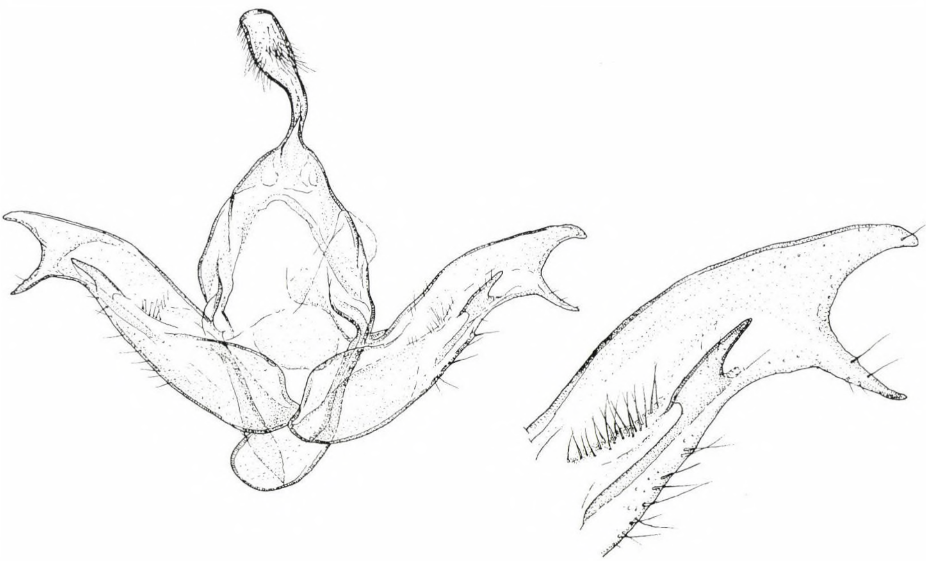


Fig. 16. *Xestia (s.l.) hypographa* sp. n., paratype, slide No. VZ7045

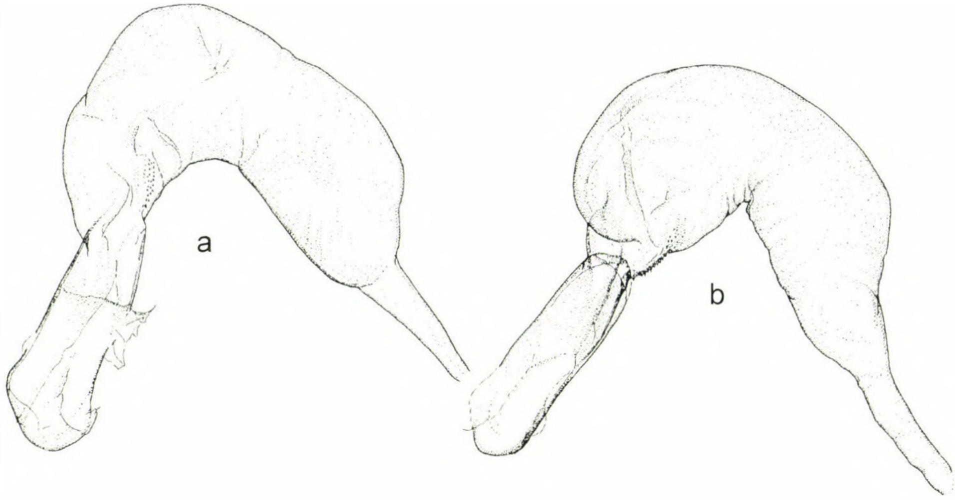


Fig. 17. 17a = *Xestia* (s.l.) *ornata* (STAUDINGER), slide No. VZ7047, 17b = *X.* (s.l.) *hypographa* sp. n., paratype, slide No. VZ7045

Male genitalia (Figs 13, 14): Uncus strong, pointed; valva straight, elongate with nearly parallel margins; harpe straight and acute apically; pollex spine-shaped, shorter; juxta shield-shaped, broader; aedeagus strong, longer; dentate ribbon with fine teeth, nearly evenly arcuate, vesica broad, less saccate, fully recurved with a tiny, acute bulbed cornutus in submedial position.

Female genitalia (Figs 38–40): Ostium bursae with triangular, rather broad and long ventral plate with slight medial incision on caudal margin. Ductus bursae long, broad, flattened, sclerotized, ventral plate with fine, narrow, longitudinal suture at middle. Apical part of bursa copulatrix membranous, wrinkled-ribbed; appendix bursae large, apex membranous, dorsal side with large, sclerotized, more or less rounded fold. Corpus bursae elliptical-ovoid, membranous; signa absent.

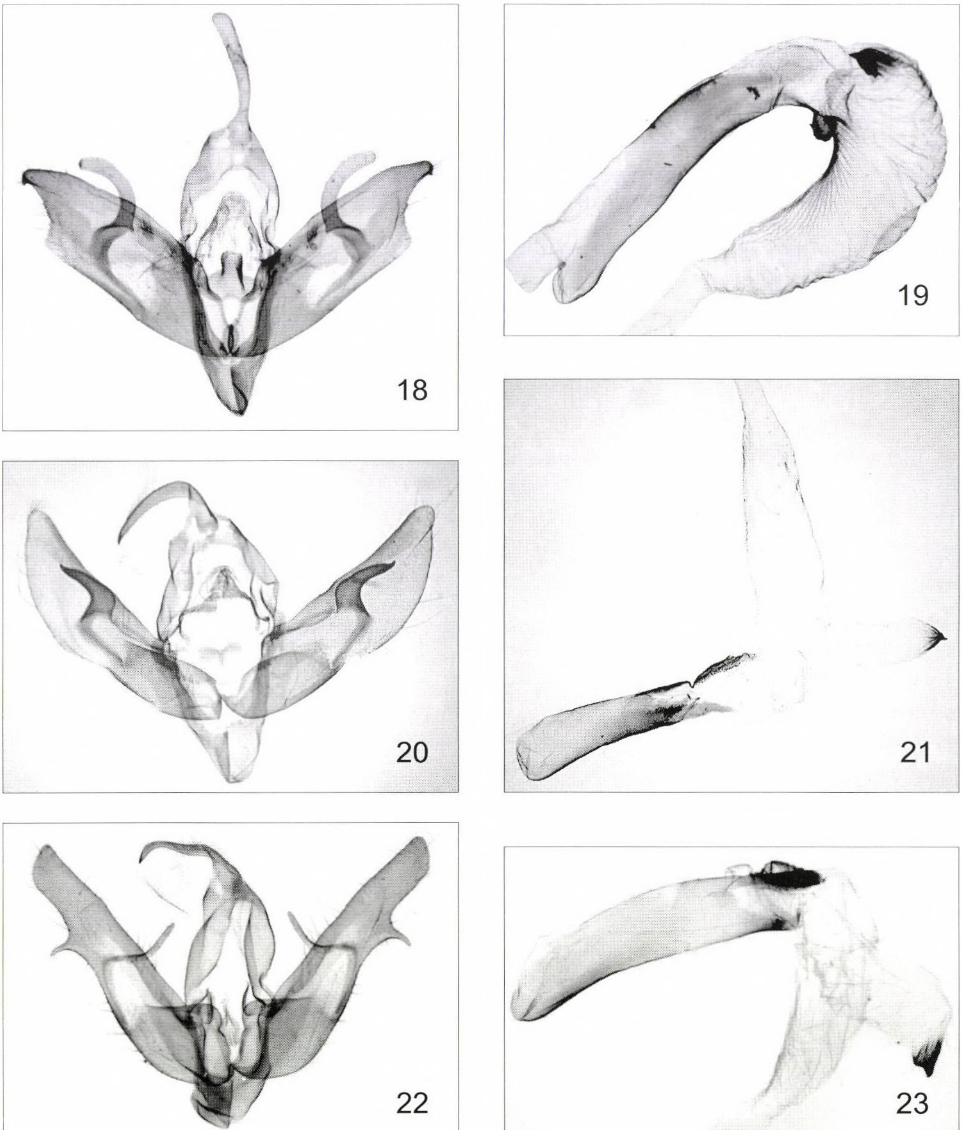
Bionomics and distribution. The new species is widely distributed in the western Tien-Shan Mts, in the Hissar and Alai Mts, in the western Pamirs (Shugnan range) and also in NE. Afghanistan (Badakhshan).

Etymology. The new species is dedicated to our friend and excellent lepidopterist, Dr. PÉTER GYULAI, who has discovered several interesting new taxa of Noctuidae in Asia.

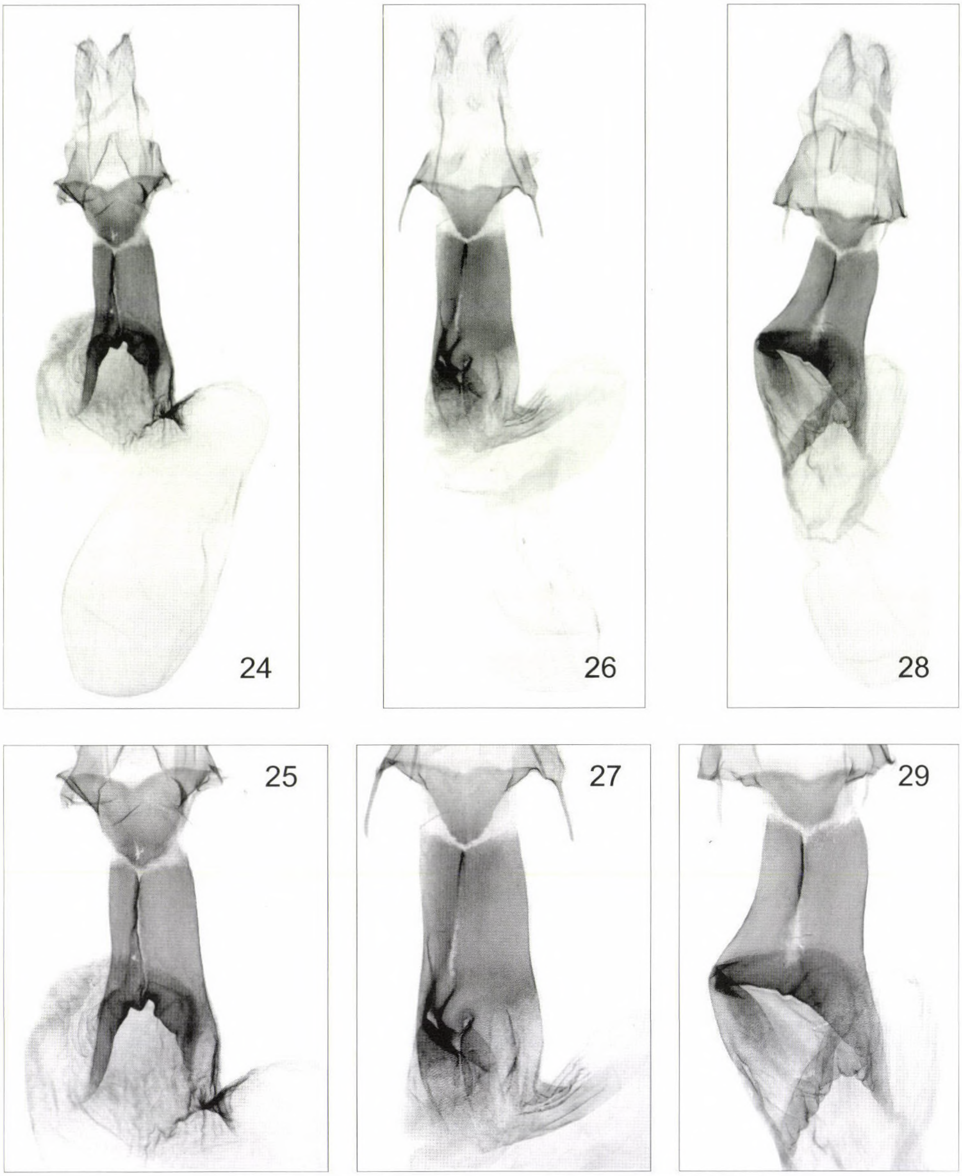
THE GENERIC PLACEMENT OF "EUGRAPHE" ORNATA AND ITS SISTER SPECIES

The curious Noctuinae species "*Eugraphe*" *ornata* was originally described as "*Hydrilla*" *ornata* STAUDINGER, 1892 (type locality: Margelan – probably the Alai Mts). HAMPSON (1903) described the same species as *Lycophotia macrina*

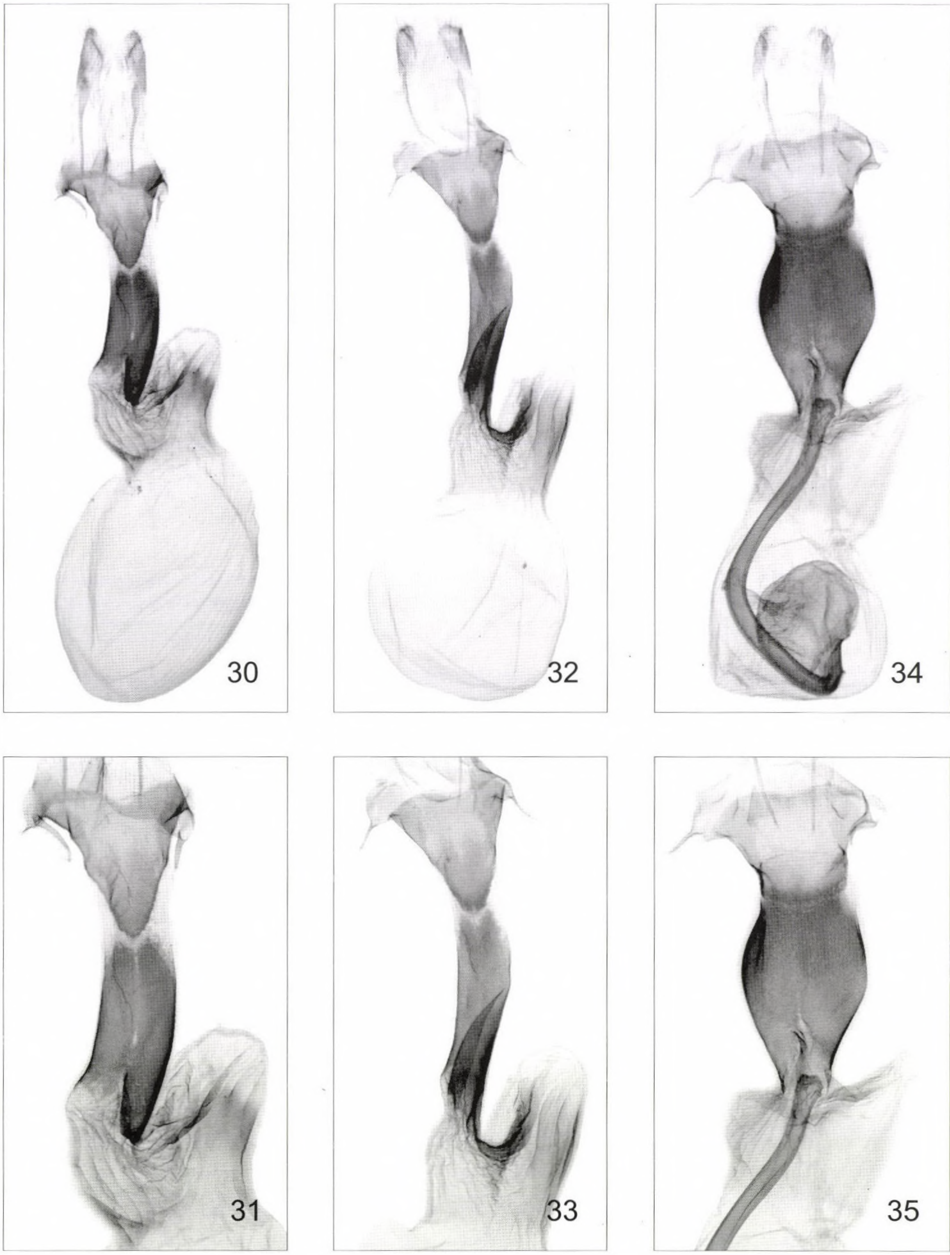
from the coll. PÜNGELER (type locality: Alexander Mts). WARREN (in SEITZ, 1910) synonymised *L. macrina* with *H. ornata* and placed it to the genus *Rhyacia*. He also provided the records of two pairs of specimens which were collected in



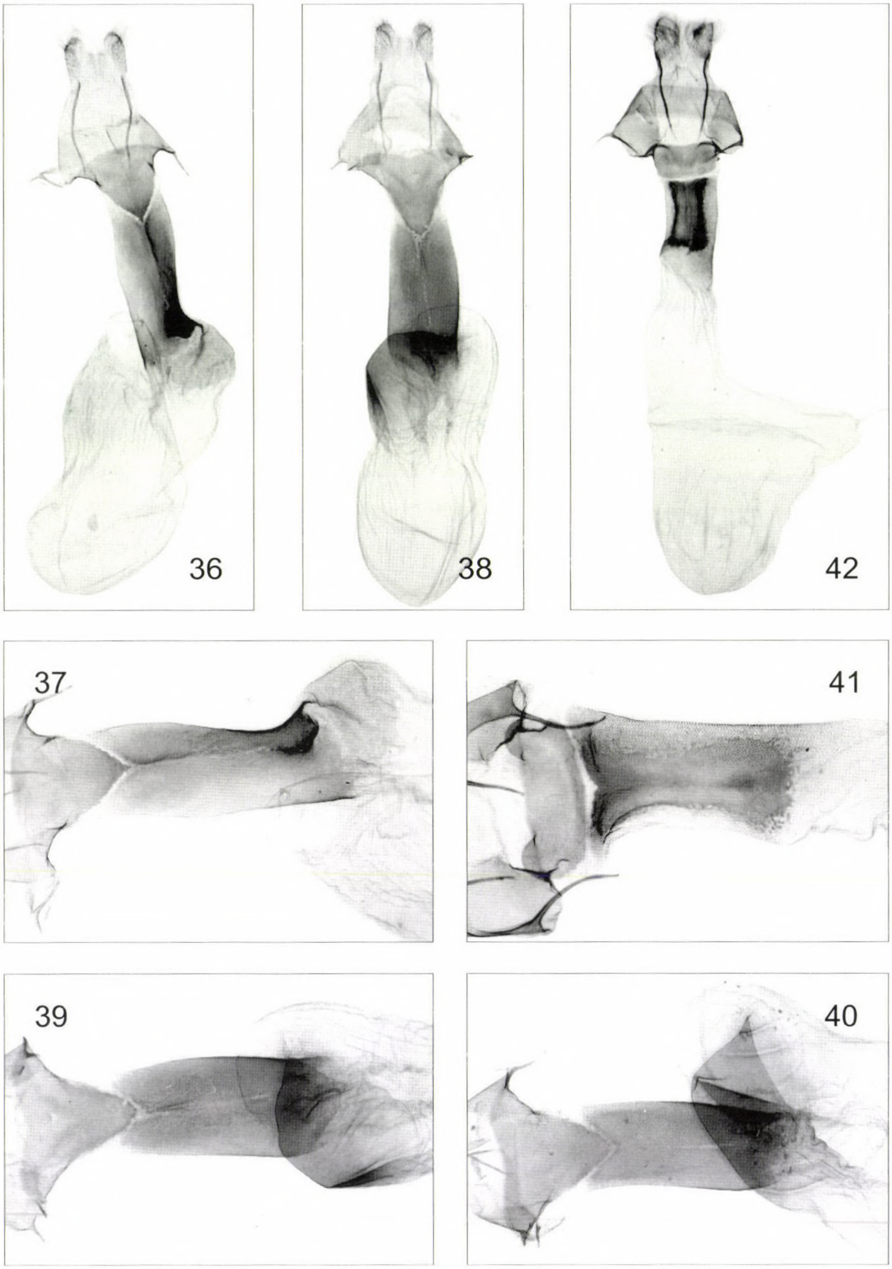
Figs 18–23. 18–19 = *Eugraphe sigma* (DENIS et SCHIFFERMÜLLER), slide no. RL7595: 18 = genital capsula, 19 = aedeagus with vesica everted; 20–21 = *Hypernaenia denticulata* (WARREN, 1888), slide no. RL7559: 20 = genital capsula, 21 = aedeagus with vesica everted; 22–23 = *"Eugraphe" versuta* (PÜNGELER), slide no. RL7503: genital capsula, 23 = aedeagus with vesica everted



Figs 24–29. 24–25 = *Goniographa decussa* (STAUDINGER), slide No. RL7531: 24 = female genitalia, 25 = posterior part in larger magnification; 26–27 = *G. discussa* sp. n., paratype, slide No. RL7481: 26 = female genitalia; 27 = posterior part in larger magnification; 28–29 = *G. shchetkini* sp. n., holotype, slide No. RL7547: 28 = female genitalia; 29 = posterior part in larger magnification



Figs 30–35. 30–31 = *Goniographa funkei* (PÜNGELER), slide No. RL7554: 30 = female genitalia, 31 = posterior part in larger magnification; 32–33 = *G. metafunkei* sp. n., holotype, slide No. RL7528: 32 = female genitalia, 33 = posterior part in larger magnification; 34–35 = *G. naumanni* sp. n., paratype, slide No. RL7584: 34 = female genitalia, 35 = posterior part in larger magnification



Figs 36–42. 36–37 = *Goniographa marcida* (CHRISTOPH), slide No. RL7477: 36 = female genitalia, 37 = posterior part in larger magnification; 38–40 = *G. gyulaipeteri* sp. n., paratypes: 38 = female genitalia, slide No. RL7501, 39–40 = posterior part in larger magnification (slide Nos RL7501, RL7502); 41 = *Xestia* (s. l.) *ornata* (STAUDINGER), slide No. RL7482, posterior part in larger magnification, 42 = *X.* (s. l.) *hypographa* sp. n., paratype, slide No. RL7542, female genitalia

Prov. Kuliab (Afghanistan), in these specimens the marginal field is not ochreous as in the type specimen but more greyish.

The study of the external and genital characters of this rather peculiar species (and its allopatric sibling) and the comparison of them with those of the taxa of *Eugraphe* inevitably showed their distinctness. Owing to the genitalia features of both sexes of *X. ornata* and *X. hypographa* sp. n. they should be placed into the genus *Xestia* (s. l.).

Xestia (s. l.) *ornata* (STAUDINGER, 1892) **comb. n.**
(Figs 15, 17, 41, 66, 67)

Hydrilla ornata STAUDINGER, 1892, *Dt. ent. Z. Iris* **4**: 296. Type locality: Margelan (?Alai Mts).

Type material examined: A syntype male from Margelan, a colour picture of which is illustrated in Fig. 66. This specimen is designated here as the lectotype of *Hydrilla ornata* STAUDINGER (coll. STAUDINGER, ZMHU Berlin).

Material examined. Kirghisia: 2 males, 5 females, Alai Mts, Tengizbai, 7.VII.1994, leg. TOROPOV & SINIAEV (coll. P. GYULAI, L. LEHMANN, Z. VARGA); 1 male, Ala-Archa valley, 20.VII.1986, leg. M. KOPP; 1 female, Alai Mts, Dugobo, 1800–2000 m, 25–26.VII.1992, leg. M. KOPP; 1 female, Alai Mts, Dugobo, 2300 m, 15.VII.1995, leg. MURZIN (coll. P. GYULAI). Tadjikistan: 1 male, 2 females, Pamir Mts, Artuch valley, 2–10.VIII.1988, coll. A.V. NEKRASOV (coll. HNHM Budapest and G. RONKAY); 1 male, Vantch, Gushon, 25.07.1988, leg. JÜRIVETE (coll. ZMUH); 4 males, 7 females, Varzob valley, Maihur, 2000 m, 12.VIII.1967, leg. SHCHETKIN; 1 male, 1 female, from the same locality, 6.VII.1967, leg. SHCHETKIN; 3 males, 5 females, Varzob valley, VIII.1967, leg. SHCHETKIN; 2 females, Karategin range, Sangikar gorge, 1700 m, 28.VIII.1969, leg. SHCHETKIN; 1 female, Peter 1st Mts, Muk, 2100 m, 27.VIII.1975, leg. SHCHETKIN; 5 males, 8 females, Peter 1st Mts, Ganishou, 2070 m, 14–18.VIII.1974, leg. SHCHETKIN; 1 male, 1 female, Hissar Mts, Kvak valley, 1800 m, 28.VII.1960, leg. SHCHETKIN; 3 males, 2 females, Hissar Mts, Gushary, 1400 m, 19.IX.1965, leg. SHCHETKIN; 4 females, Hissar Mts, Kondara valley, 1800 m, 20.VIII.–1.IX.1994, leg. SHCHETKIN; 1 male, Hissar Mts, Iskanderful, 1900–2300 m, 19–21.VII.1994, leg. LUKHTANOV; 2 females, Obichingou river, n. Tawildara, 1850 m, 2.IX.1970, leg. SHCHETKIN; 1 female, Seravshan Mts, Iskander-kul, 2200 m, 23–25.VII.1968, leg. SHCHETKIN; 1 female, Seravshan Mts, 17.VII.1988 (coll. A. BECHER, P. GYULAI & J. STUMPF). Afghanistan: 1 male, Badakhshan, Darwaz, Shewa valley, Basindj, 1900–2000 m, 27.VIII.1973., leg. Naumann & Nauruz (coll. VARGA), 2 females, prov. Kadaghan, Salang-pass N-side, 69°w, 35°40'l, 2400 m, 11–12.VII.1972. leg. Vartian (coll. VARTIAN, NHMW).

Slide Nos RL2492m, RL7483m, RL7550m, VZ7047, VZ7065 (males), RL7482f, RL7543f (females).

Diagnosis: Moths of smaller size with conspicuously slender body, showing some external similarity to the species of the *Caradrina* genus-group (see the taxonomic misplacement of the species by STAUDINGER). It is quite dissimilar to all related Noctuinae spp., but rather similar to the newly described species, *X. hypographa* sp. n. The most important differential characters are the very large, sharply defined orbicular and reniform stigmata with light ochreous filling, the sharply

marked, light ochreous ante- and postmedian lines, the light ochreous cilia and also several characters in the genitalia of both sexes, see below in the diagnosis of *X. hypographa*.

Description. Wingspan 28–36 mm, length of forewing 13–16 mm. Head and conspicuously long, slender abdomen light ochreous grey, thorax slighly darker and more greyish. Antenna filiform, with short and dense ciliation (male) or thin, filiform without ciliation (female). Forewing narrow triangular, acute apically. Ground colour ochreous grey, often with some greenish colouration; sharply marked, reniform stigma large, broad with light ochreous filling and sharply defined with black scales; orbicular spot broad, elliptical, light ochreous, sharply defined with black scales. Ante- and postmedial lines double, crenulate with ochreous filling; the outer side of antemedial and the inner side of postmedial is sharply defined with black scales. Subterminal line fine, broken, often with 2–3 arrowheads at the inner side. Hindwing light ochreous grey, shiny. Cilia light ochreous. Sexes similar, females slightly darker, with somewhat more elongate forewings.

Male genitalia (Figs 15, 17a): Uncus obtuse but less spatulate than in case of the new species; cucullus and corona fully reduced. Valva pointed apically, pollex short or moderately elongate, harpe tiny, shorter but broader than in the new species, finely rounded apically. Sacculus simple, clavus reduced, juxta broad, rounded trapezoidal, weakly sclerotised. Aedeagus simple with dentate ribbon on the carina, dentate ribbon of aedeagus more sclerotised, more and unevenly dentate than in the new species; vesica saccate without cornuti and sclerotised elements.

Female genitalia (Fig. 41): Ostium bursae sclerotized, quadrangular, broad and short, caudal margin with two small, ear-like postero-lateral appendages. Ductus bursae medium-long, broad, flattened, granulously sclerotized, ventral surface with stronger medial plate. Sclerotization of anterior part asymmetrical, considerably longer on left side. Appendix bursae large, subconical, weakly membranous, finely wrinkled, projected proximo-laterad. Corpus bursae elliptical, membranous, with four short, weak signum-stripes at fundus bursae.

Bionomics and distribution: The species is distributed from the northern Tien-Shan Mts. through the Pamirs and Hissar-Darwaz system to eastern Afghanistan (Nuristan).

Etymology: The name refers to the conspicuously rich and colourful markings of the species.

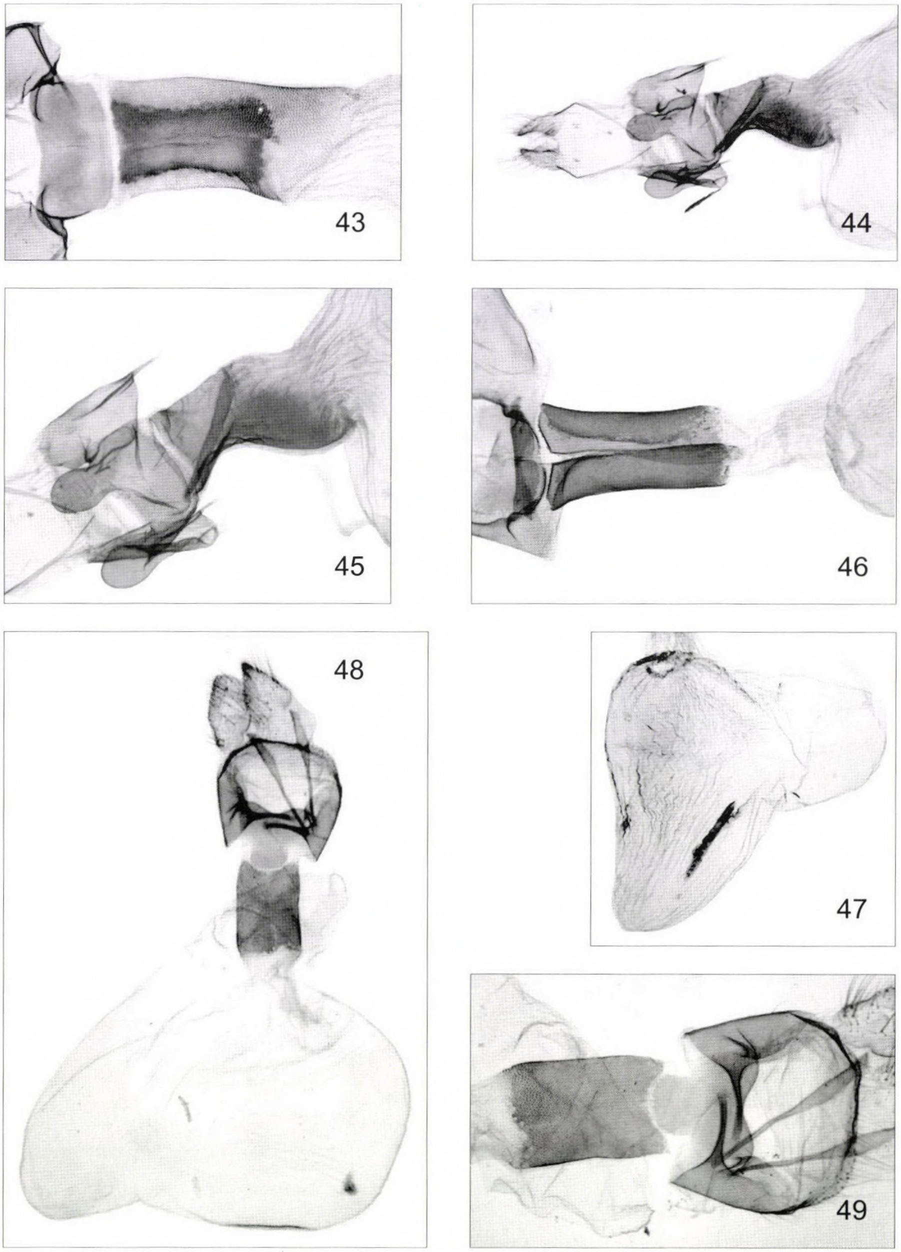
Xestia (s. l.) hypographa sp. n.
(Figs 16, 17, 42, 43, 68, 69)

Holotype: male, Talassky Alatau Mts, Kara-Bura pass, 1800 m, 42°18'N, 71°35'E, 29.VII. 1993, leg. V. & A. LUKHTANOV; slide No. RL7565m (coll. P. GYULAI).

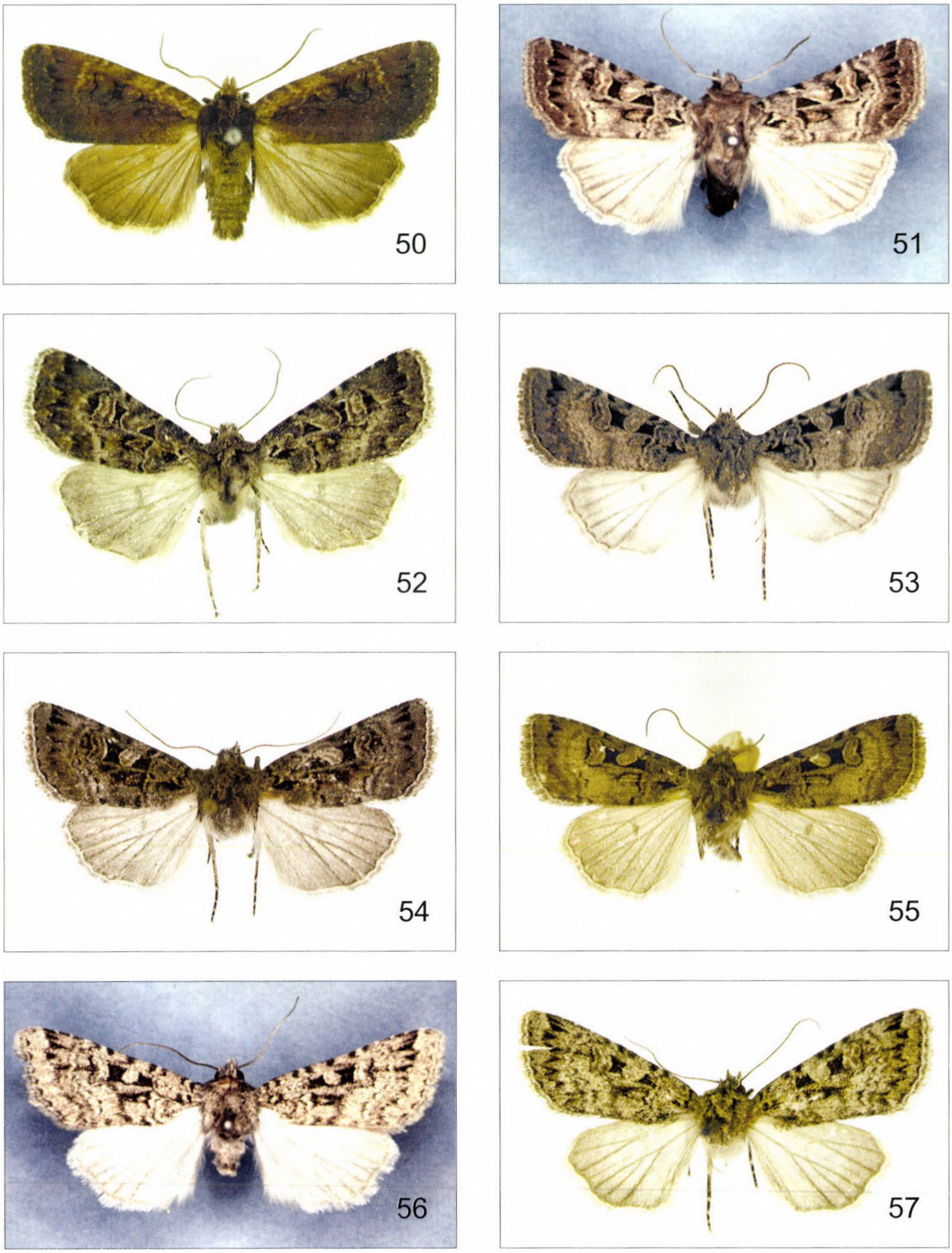
Paratypes. Kirghisia: 4 females, Susamyr Mts, valley of Chickhan river, 1800 m, 29–30.VII. 1994, leg. TOROPOV & SINIAEV; 1 female, Kirghiz Mts, Kara Baitta valley, Sosnovka, 3–4.VIII.1999, leg. PLYUSHCH (coll. P. GYULAI and G. RONKAY). Uzbekistan: 1 male, W. Tien-Shan, Chimgan Mts, 1300 m, 23.09.1991. leg. JÜRIVETE (coll. ZMUH).

Slide Nos VZ7045 (male), RL7529f, RL7530f, RL7542f (females).

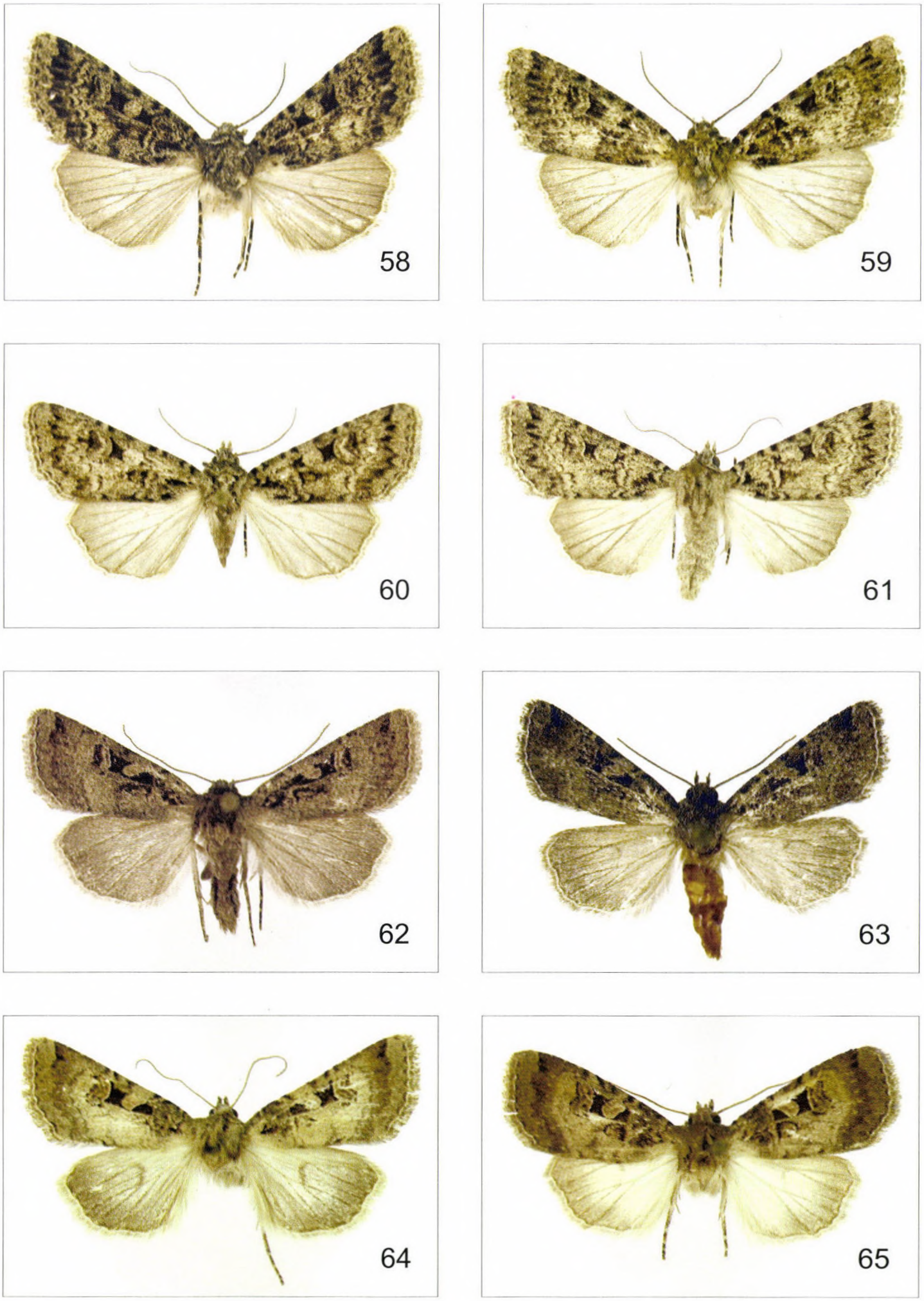
Diagnosis: Forewing is somewhat broader, apex less elongate, than in *X. ornata*; ground colour is more greyish-greenish, the ochreous colouration is sup-



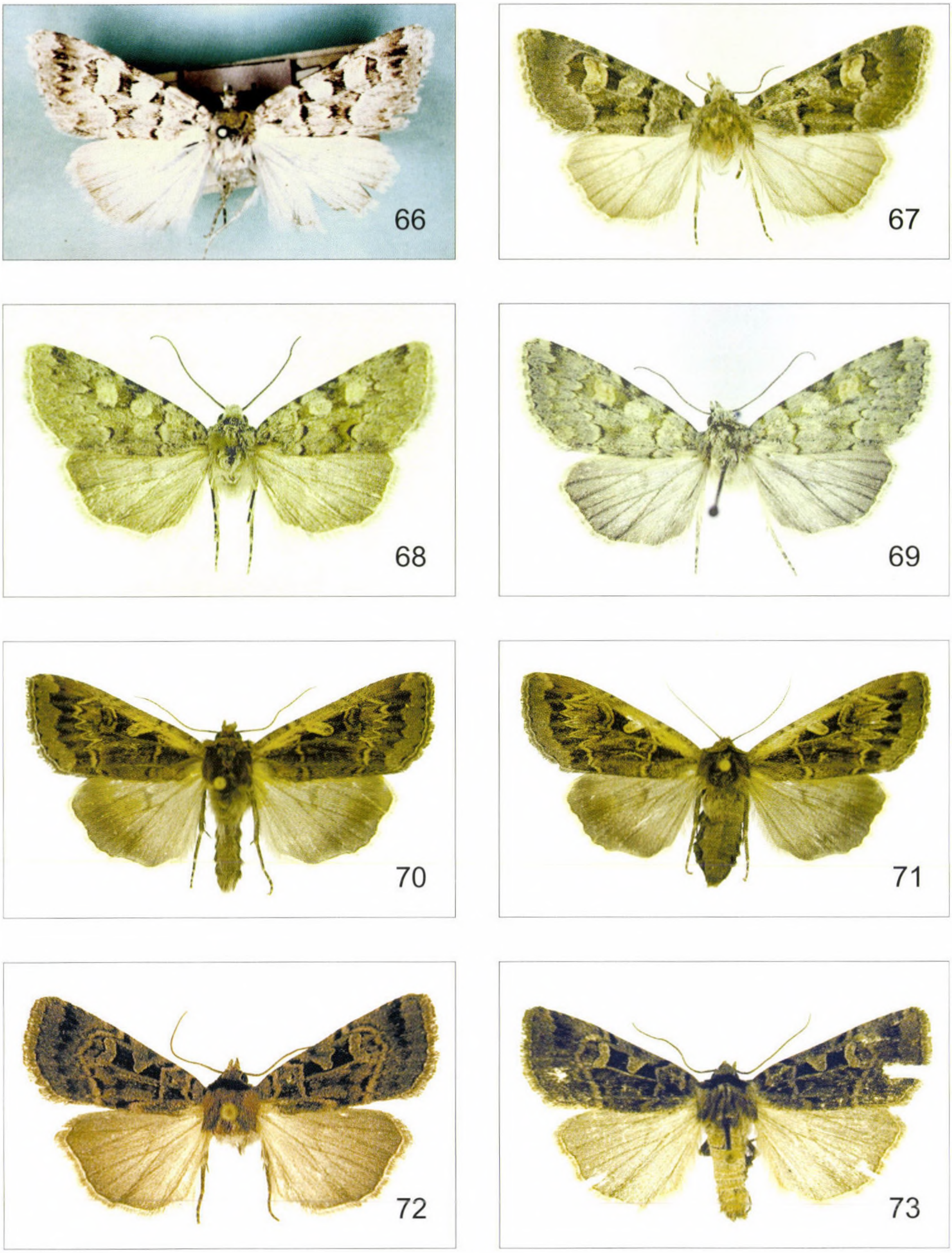
Figs 43–49. 43 = *Xestia (s. l.) hypographa* sp. n., paratype, slide No. RL7542, posterior part in larger magnification; 44–45 = *Eugraphe sigma* (DENIS et SCHIFFERMÜLLER), slide No. RL7596: 44 = female genitalia, 45 = posterior part in larger magnification; 46–47 = *Hypernaenia denticulata* (WARREN), female genitalia, slide No. RL7560: 46 = posterior part, 47 = anterior part; 48–49 = *"Eugraphe" versuta* (PÜNGELER), slide No. RL7504: 48 = female genitalia, 49 = posterior part in larger magnification



Figs 50–57. 50 = *Eugraphe sigma* (DENIS & SCHIFFERMÜLLER) male,; 51–52 = *Goniographa decussa* (STAUDINGER): 51 = lectotype, 52 = female, Uzbekistan; 53–54 = *G. discussa* sp. n.: 53 = holotype, 54 = paratype female, Tadjikistan; 55 = *G. shchetkini* sp. n., holotype; 56–57 = *Goniographa funkei* (PÜNGELER): 56 = lectotype, 57 = female, Tadjikistan



Figs 58–65. 58–59 = *Goniographa metafunkei* sp. n.: 58 = holotype, 59 = paratype male, Kirghisia; 60–61 = *G. naumanni* sp. n.: 60 = holotype, 61 = paratype female, Afghanistan; 62–63 = *G. marcida* (CHRISTOPH): 62 = male, Turkmenistan, 63 = female, NE Iran; 64–65 = *G. gyulaipeteri* sp. n.: 64 = holotype, 65 = paratype male, Tadjikistan



Figs 66–73. 66–67 = *Xestia (s. l.) ornata* (STAUDINGER): 66 = lectotype, 67 = female, Tadjikistan; 68–69 = *X.* (s. l.) *hypographa* sp. n.: 68 = holotype, 69 = paratype, female, Kirghisia; 70–71 = *Hypernaenia denticulata* (WARREN): 70 = male, 71 = female (both from NW Pakistan); 72–73 = *"Eugraphe" versuta* (PÜNGELER): 72 = male, 73 = female (both from Mongolia)

pressed by the densely dispersed darker scales; the wing pattern is less sharply marked, reniform and orbicular stigmata are narrower, more greyish.

The male genitalia of the two sister species differ in the following features (see Figs 15–17): the uncus of the new species is more spatulate and obtuse than that of *X. ornata*, the pollex is longer, almost straight and more pointed; the harpe is significantly thinner, longer, apically acute; the dentate ribbon of the carina is thinner, evenly serrulate, the vesica is more saccate, especially in the basal half.

The ground plan of the female copulatory organ is the same in the two sibling species (Figs 41–43), but the ostium bursae of the new species is significantly longer, narrower and the appendix bursae is projected laterally while that of *X.* (s. l.) *ornata* is situated closer to fundus bursae and projected proximo-laterally.

Description: Relatively small moths with slender body, wingspan 32–34 mm, length of forewing 14–15 mm. Sexes similar, females somewhat larger, more broad-winged. Head and abdomen light ochreous grey, slightly darker than in ther former species, thorax slightly darker ochreous grey. Antenna filiform, in male ciliate. Forewing triangular with rounded apex and outer margin; ground colour darker greenish-ochreous grey. Orbicular and reniform stigmata regular, lighter than the ground colour, not sharply defined. Claviform spot obsolescent. Ante- and postmedial lines double, not sharply defined. Subterminal line obsolescent. Hindwing ochreous grey. Cilia ochreous grey.

Male genitalia (Figs 16, 17b): Uncus spatulate, obtuse apically. Cucullus and corona reduced. Valva pointed apically, pollex pointed, straight, longer than in *X. ornata*; harpe tiny, acute apically, clavus reduced, juxta broad, weakly sclerotised. Aedeagus simple, carina with thin, evenly serrulate-dentate ribbon; vesica saccate without cornuti or other sclerotised elements.

Female genitalia (Figs 42, 43): Ovipositor short, weak; gonapophyses slender, fine. Ostium bursae sclerotized, quadrangular, relatively long and narrow, caudal margin evenly convex, with two small, ear-like postero-lateral appendages. Ductus bursae medium-long, flattened, broadly tubular, both surfaces granulously sclerotized, ventral plate with stronger medial plate. Sclerotization of anterior part asymmetrical, considerably longer on left side. Apical part of corpus bursae membranous, finely wrinkled-ribbed; appendix bursae large, subconical, weakly membranous, finely wrinkled, projected laterad. Corpus bursae elliptical-saccate, membranous, with four short, narrow signum-stripes close to fundus.

Bionomics and distribution: The new species is known only from the north-western part of the Tien-Shan Mts.

Etymology: The name refers to the main external differential feature of the species: the less distinct forewing markings.

*

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